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ABSTRACT

Intended to be used as a teaching and learning guide, the basic course of study presented in these materials is designed to provide the essentials of the metal fabrication trade, insuring that the students who successfully complete the course will have sufficient competencies for initial employment and ample orientation for growth and development. The course of study is designed as a 3-year curriculum involving approximately 1,500 hours of class and laboratory instruction. The material has been arranged in major divisions of the trade: (1) Pattern Drafting and Layout, (2) Fabrication, (3) Welding, and (4) Installation and Repair. The content of this course material consists of job sheets, which indicate to the student what to do in performing various job assignments, and skill competency sheets, which supplement job sheets and indicate to the student how to perform the manipulative handling of tools and materials that make up the doing part of the occupation. They are simply written and highly illustrated. A cumulative reuse of the skill competencies continues throughout the entire job sheet collection. The job sheets are arranged in an order that gradually exposes the skill competencies to insure the introduction of each operation or skill competency in a controlled manner. Included for use by the teacher are general course objectives, suggested teaching methods and vehicles of instruction, and a list of items to be developed by the local teacher. Sample information sheets, sample assignments sheets, and a bibliography are included. (HD)

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ED136063

TRADE AND INDUSTRIAL EDUCATION

COURSE OF STUDY

FOR

METAL FABRICATION

U S DEPARTMENT OF HEALTH.
EDUCATION & WELFARE
NATIONAL INSTITUTE OF
EDUCATION

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Harrisburg, Pennsylvania

1976

CE 010 381

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PREFACE

In recent years, we have planned and constructed the finest of vocational education facilities and have placed fine equipment in these facilities. Equal attention must be directed to provide the teacher with the basic tools for instruction to assist in providing quality instruction.

This basic course of study is intended to be used as a teaching and learning guide. The information provides the essential of the occupation, insuring that the students who successfully complete the course will have sufficient competencies for initial employment and ample orientation for growth and advancement. The teacher who uses this course may find it necessary to modify and supplement the material to meet the needs of specific students and the local industrial community.

This material has been prepared by a committee of teachers under the general direction of the staff of the Division of Occupational and Vocational Studies at The Pennsylvania State University in cooperation with the Trade and Industrial Education staff of the Bureau of Vocational Education of the Department of Education.

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COURSE PHILOSOPHY

This course of study in Metal Fabrication meets the needs of secondary students who seek specialized training in order to enter the labor market. Opportunities will be provided to encourage development of skill, knowledge and attitudes necessary for the student to function on the job, as well as enhance his citizenship qualities.

It is planned that each student may progress at a rate most appropriate for his background, desires and abilities. Those students showing leadership qualities will have the opportunity to exercise and develop those qualities. Group projects will be designed to encourage work cooperation and provide leadership functions. Safety on the job and safety in the design and fabrication of products will be a regular consideration. Pride and dignity of work accomplishments will be of utmost importance.

GENERAL COURSE OBJECTIVES

Objectives	Suggested Activities to Achieve Objectives
1. To develop specific skills and related knowledge associated with the occupation of metal fabrication worker.	1. Series of individual jobs. 2. Practice exercises. 3. Series of group jobs. 4. Provide job sheets, operation sheets, information sheets, and assignment sheets for individual student use. 5. A portion of each session will be devoted to classroom instruction.
2. To develop an understanding of labor and management.	1. Assign reading in several trade magazines. 2. Arrange field trips. 3. Discussions on labor and management problems. 4. Present speakers from industry.
3. To develop good work habits and attitudes.	1. Provide specific standards for each work job. 2. Provide a clean, well-organized practice area conducive to learning. 3. Discuss importance of good work habits in relation to industrial practice, job advancement, etc. 4. Provide a means for students to plan their work accurately and methodically. 5. Measure students work objectively.
4. To develop safety habits and their value in metal fabrication work.	1. Display safety posters. 2. Provide safety devices for all hazardous work. 3. Demonstrate correct safety practice when possible. 4. Show movies on safety. 5. Student safety committee will be actively involved in program.
5. To develop ability to work cooperatively with fellow workers.	1. Set up maximum of class and group projects. 2. Encourage students to seek help from each other. 3. Assign more advanced students to help students needing assistance. 4. A percentage of time will be spent in group activities.

Objectives	Suggested Activities to Achieve Objectives
6. To develop in each student the habits of self-reliance and resourcefulness.	1. Provide for students to design and plan some of their projects. 2. Provide a plan by which the student appraises his own work.

PLAN OF INSTRUCTIONAL PRACTICE

The effectiveness of instruction depends on the careful organization and control of the routine details concerning the management of the pupil, equipment, teaching methods and the physical laboratory arrangement. The teacher must determine the best management practices and formulate a very definite statement of the basic standards to be followed in teaching the course to bring about the attainment of the learning goals.

Length of Course

The course of study is designed as a three-year curriculum involving approximately 1500 hours of class and laboratory instruction, primarily for beginning students who are interested in securing employment in the occupation. Where job entry is the goal, the entire course of study would be appropriate. In adults programs, it may be found that a single thrust is the student's goal, therefore, the course content may be restricted to a single major division.

Use of This Course of Study

The material has been arranged in major divisions of the trade. In most cases, the material contained in the first division must be learned before progressing to the next division. The nature of some trade areas permit entry into random divisions after the introductory basic material is covered. Some divisions of the occupation can be taught separately.

The content of this course material consists of job sheets (yellow) and skill competency sheets (white). The skill competency sheets are simply written and highly illustrated. These sheets outline the manipulative handling of tools and materials that make up the doing part of the occupation. The sequence of the skill competency sheets (SC) is based on the organization of the job sheets. Notice that job number one incorporates the basic skill competencies and job number two includes additional skill competencies. This cumulative reuse of the skill competencies continues throughout the entire job sheet collection. After a number of jobs have insured that the student has been sufficiently exposed to a skill competency, no further reference to that skill competency is made.

The job sheets are arranged in an order that gradually exposes the skill competencies. The purpose of the job sheet is to insure the introduction of each operation or skill competency in a controlled manner. Look at this group of jobs as a framework that can be added to, by you, to meet local needs. You may decide to design new or different jobs that will be inserted between or replace any of the suggested jobs. In time you will be able to custom design a course of study for your own needs. There will be little or no need to vary the skill competency sheets.

Teaching Methods

The following procedures are offered as the most productive in achieving the desired results in this course.

1. Demonstrations--Operations and Procedures will be demonstrated while the students observe. The purpose is to show how things are done correctly and safely.

2. Class Discussion--A method of teaching in which the students and the teacher take part, directed and controlled by the teacher to a predetermined objective. Technical and related information common to a class or group of students will be presented in this manner. Evaluation of the material presented in this manner should be done by objective testing.

3. Laboratory Talks--Short, informal talks by the instructor during laboratory activities to convey information pertinent to the activity in progress. Not scheduled and not timed, this activity should occur at any appropriate time and for periods of varying duration.

4. Observation and Input--This teacher activity should take place at all times when students are performing psychomotor skills. The purpose is to reinforce a previously given demonstration, class discussion, or laboratory talk, or to update the students' skills by further demonstration an/or further disclosures of technical and related information.

Vehicles of Instruction

The application phase of this course will consist of work assignments kept as close to industrial conditions as a shop situation permits. Job, operation and information sheets will be provided, so that students of different levels of skill and ability can understand them. The students will be encouraged to progress as rapidly as possible, and achieve the standard set for the course. Special attention will be given to the unique student, offering special assistance so that slow as well as fast students may progress at their own rate of speed.

Items for Development by Local Teacher

The following items are peculiar to the local school situation and need to be developed by each local instructor.

- Standards of attainment required of students
- Pupil work evaluation and grading
- Shop controls and regulations
- Pupil personnel organization
- Method of tool control
- Records and forms

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COURSE OUTLINE

Instructional Title: Metal Fabrication   Code: 17.2392

OCCUPATION DESCRIPTION

Classroom and shop experiences in the planning and layout of various shapes in light and heavy gage metals, involving the use of various hand tools, welding equipment, and the operation of presses, shears, forming and shaping machines, rotary cutters, metal cutting band saws, etc. Related information in drafting techniques as applied to pattern development, mathematics as applied to the work of the sheet metal fabricator, along with the theories of the occupation, are included.

MAJOR DIVISIONS OF THE OCCUPATION

I. Pattern Drafting and Layout

II. Fabrication

III. Welding

IV. Installation and Repair

SKILL COMPETENCY DEVELOPMENT JOBS

The following is a list of jobs, assigned by the teacher, to provide experience for the student to help develop his competency in the Metal Fabrication trade. These are job titles only. The numbers correspond with the identifying numbers of the job sheets that follow.

UNIT I. PATTERN DRAFTING AND LAYOUT

J-1-1 Fasten Paper to Board

J-1-2 Square Paper

J-1-3 Draw Parallel(Vertical and Horizontal Lines)

J-1-4 Draw Circles

J-1-5 Draw Polygons

J-1-6 Geometrical Drawings

J-1-7 Drawing to Scale

J-1-8 One Piece Box

J-1-9 Flat Duct Elbow

J-1-10 Layout an 8" Two Piece 45° Flue Pipe Elbow

UNIT II. FABRICATION

J-2-1 Find a Piece of Metal 3" X 7"

J-2-2 Lay Out a Single Hem

J-2-3 Bend a Single Hem

J-2-4 Bend a Double Hem

J-2-5 Make a One Piece Box

J-2-6 Make a Grooved Seam

J-2-7 Make a Pan

J-2-8 Make a Metal Disc

J-2-9 Shear with Chisel on Vise

J-2-10 Cut Round Hole in Square Plate

J-2-11 Make a Standing Seam

J-2-12 Fabricate a Cylindrical Pipe

J-2-13	Cut a Cylindrical Pipe in Two with Double Cutting Shears
J-2-14	Crimp and Bead Two Pieces of Cylindrical Pipe
J-2-15	Burr End of Pipe
J-2-16	Eight Inch Two Piece 45^0 Flue Pipe Elbow
J-2-17	Fabricate a Round Pipe with Riveted Lap Seam
J-2-18	Fabricate a Heavy Gage Round Pipe with Riveted Lap Seam
J-2-19	Fabricate a Duct with Pittsburgh Lock
J-2-20	Flat Duct Elbow
J-2-21	Heavy Flat Duct Elbow
J-2-22	Fabricate and Install Slips and Drive Clips
J-2-23	Fabricate Cylindrical Pail
J-2-24	Fabricate a Funnel
J-2-25	Angle Iron Shelf Bracket
J-2-26	Metal Liner
J-2-27	Fabricate Angle Iron
J-2-28	Fabricate a Drain Cover
J-2-29	Vent Pipe (Through Wall)
J-2-30	Make Washers
J-2-31	Aluminum Mini-Box
J-2-32	Cut a 10" Diameter Circle
J-2-33	Cut an Eight Inch Square Plate Coordinate Nibbling
J-2-34	Slot a Hole in a Plate
J-2-35	Cut or Shear Strips with Metal Worker
J-2-36	Flange a 10" Diameter Disc
J-2-37	Ventilator Cap
J-2-38	Air Scoop
J-2-39	Tapered Bucket
J-2-40	Tool Chest

J-2-41	Make an Ash Tray Stand
J-2-42	Make a Magazine Rack
J-2-43	Make a Rectangular Hopper
J-2-44	Pitched Cover
J-2-45	Make a Portable Ice Chest
J-2-46	Make a Duct Transition - Three Sides Straight
J-2-47	Make a Duct Transition - Two Sides Straight
J-2-48	Make a Duct Transition - One Side Straight
J-2-49	Make a Square to Round Transition - Centered
J-2-50	Make Rectangular to Round Transition - Centered
J-2-51	Make a Rectangular to Round Transition - Off Center
J-2-52	Three Piece 90° Tapering Elbow
J-2-53	Make an Outside Barbecue Grill
J-2-54	Make a Slant Legged Coffee Table
J-2-55	Heavy Conical Jack Stand
UNIT III.	WELDING
J-3-1	Transport Cylinders
J-3-2	Assemble Hoses and Equipment
J-3-3	Open and Adjust Gas Pressures
J-3-4	Light, Adjust and Close Torch
J-3-5	Clean Torch Tip
J-3-6	Fusion Weld with No Rod
J-3-7	Fusion Weld with Rod
J-3-8	Three Inch Welded Cube
J-3-9	Tie Rack
J-3-10	Torch Solder Double Seam Bottom
J-3-11	Attach, Light and Adjust Cutting Torch

J-3-12	Cut Square Plate
J-3-13	Pierce Round Holes
J-3-14	Radius Bend 1/2" Round Rod
J-3-15	Heat Shrink Stretched Panel
J-3-16	Arc Weld Stringer Beads
J-3-17	Arc Weld Horizontal Beads
J-3-18	Arc Weld Vertical Bead Down
J-3-19	Arc Weld Vertical Bead Up
J-3-20	Arc Weld Overhead Beads
J-3-21	Arc Weld a Butt Joint
J-3-22	Arc Weld Edge Joint
J-3-23	Arc Weld Corner Joints
J-3-24	Arc Weld a Tee Joint
J-3-25	Arc Weld a Lap Joint
J-3-26	Arc Weld Pipe (Practice Beads)
UNIT IV.	INSTALLATION AND REPAIR
J-4-1	Install Window Awning
J-4-2	Make a Wrought Iron Porch Post
J-4-3	Make a Wrought Iron Railing
J-4-4	Fabricate Roof Ventilator
J-4-5	Install Half Round Gutter
J-4-6	Fabricate "K" or Box Gutter
J-4-7	Make a Range Canopy (Back Straight)
J-4-8	Make a Clothes Rack
J-4-9	Fabricate and Install Outside Lamp Post
J-4-10	Install Wrought Iron Railing

J-4-11	Remove and Replace Broken Conductor Elbow
J-4-12	Install Metal Liner in Wood Flower Box
J-4-13	Fabricate and Install Plenium Chamber
J-4-14	Install Prefabricated Square Duct
J-4-15	Install Chimney Flashing
J-4-16	Install Heavy Gage Furnace Breeching
J-4-17	Replace Worn Bottom of a Copper Pan
J-4-18	Reweld Cracked Tank
J-4-19	Repair Rusted Gutter Outlet

SKILL COMPETENCIES AND INFORMATION LESSONS

The left hand column lists the tasks of the occupation which form the skill competencies required of the student. These competencies should be demonstrated by the teacher and practiced by the student.

The information lessons outline the general technical information and knowledge needed to perform the skill competencies. These items represent a common information taught on a group instruction basis. Additional information will emerge to be taught on an individual student basis as pupils work on the skill competencies.

The numbers preceding each title correspond to the identifying numbers of the operation sheets and the information sheets. The information lessons relate to the particular major unit on instruction but do not necessarily relate to corresponding skill competency numbers.

UNIT I. PATTERN LAYOUT

SKILL COMPETENCIES/OPERATIONS The student will be able to:		INFORMATION LESSONS	
SC-1-1	Placing Paper on Drawing Board	IL-1-1	Proper Drawing Paper and Pencils
SC-1-2	Positioning and Moving a T-Square	IL-1-2	Care and Use of the Drawing Equipment
SC-1-3	Using the 1" Scale Rule	IL-1-3	Measuring Drawings that are Drawn to Scale
SC-1-4	Using Plastic Angles	IL-1-4	Measuring Tools
SC-1-5	Using the Drawing Tools	IL-1-5	The Three Main Purposes of the Circumference Rule
SC-1-6	Using the Architect's Scale	IL-1-6	Geometric Measuration
		IL-1-7	Roof Pitch
		IL-1-8	The Parts of a Circle
		IL-1-9	The Parts of a Triangle
		IL-1-10	Polygons
		IL-1-11	Drawing Lines and Their Meaning
		IL-1-12	Blue Print Symbols
		IL-1-13	Trade Terms
		IL-1-14	Trade Mathematics

SKILL COMPETENCIES/OPERATIONS The student will be able to:	INFORMATION LESSONS
	IL-1-15 Blue Print Reading
	IL-1-16 Care and Use of the Architects Rule

UNIT II. FABRICATION

SKILL COMPETENCIES/OPERATIONS The student will be able to:	
SC-2-1	Measuring and Marking with a Bench Rule and Scribe or Pencil
SC-2-2	Scribing a Line with a Scratch Awl and a Straight Edge
SC-2-3	Bending Metal on the Cornice Brake
SC-2-4	Marking Metal with a Prick or Center Punch
SC-2-5	Making a Straight Cut with Straight, Combination or Bulldog Snips
SC-2-6	Notching Metal
SC-2-7	Forming Metal on the Bar Folder
SC-2-8	Grooving Seams with Hand Groover
SC-2-9	Bending Sides on Box or Pan on the Box and Pan Brake
SC-2-10	Cutting Outside Curved Cuts with Combination Shears
SC-2-11	Cutting Metal with a Hammer and Chisel
SC-2-12	Assembling Wired Edge on Stakes Using Pliers and Setting Down Hammer
SC-2-13	Making an Inside Curved Cut with Hand Shears
SC-2-14	Shearing Metal in a Foot Squaring Shear
SC-2-15	Scribing Lines with a Marking Gage

INFORMATION LESSONS	
IL-2-1	The Many Uses of the Framing Square
IL-2-2	Gage Capacities of Machines
IL-2-3	Lubrication and Maintenance of Machines
IL-2-4	Accident Prevention Procedures for Machine Work
IL-2-5	Miscellaneous Hand Tools Scribe, Prick Punch
IL-2-6	Punches; Types and Construction
IL-2-7	Factors Determining Punch Sizes
IL-2-8	Brakes; Types and Construction
IL-2-9	Determining Minimum Flanges which can be Formed on Brakes
IL-2-10	Determining Proper Bending Sequence on Brakes
IL-2-11	Care and Use of Hand Snips
IL-2-12	Coper, Notcher Shear; Types and Construction
IL-2-13	Factors Determining Use of Coper Notcher Shear
IL-2-14	Bar Folders; Types and Constructio
IL-2-15	Various Edges and Folds that can be Formed on Bar Folders
IL-2-16	Types of Metals
IL-2-17	Gages of Metals
IL-2-18	Metal Bender; Types and Uses
IL-2-19	Types and Shaped of Materials that can be Formed on Metal Bender

SKILL COMPETENCIES/OPERATIONS
The student will be able to:

SC-2-15A	Gaging Lines with the Combination Square
SC-2-15B	Gaging Lines with a Rule and Pencil
SC-2-16	Forming Cylindrical Shapes on the Slip Roll Forming Machine
SC-2-17	Forming Pipelock Seam with Machine
SC-2-18	Using the Double Cutting Shears
SC-2-19	Crimping Metal with a Combination Rotary Machine
SC-2-20	Beading with the Combination Rotary Machine
SC-2-21	Burring an Edge on the Burring Machine
SC-2-22	Forming an Elbow Lock with a Combination Rotary Machine
SC-2-23	Punching Holes with Hand Punch
SC-2-24	Upsetting a Rivet
SC-2-25	Riveting with a Pop Rivet Gun
SC-2-26	Cutting Metal in Power Shears
SC-2-27	Rolling Metal in Power Rolls
SC-2-28	Forming Pittsburgh Lock with Lock Forming Machine
SC-2-29	Assembling Pittsburgh Lock
SC-2-30	Forming a Flange on the Easy Edger

INFORMATION LESSONS

IL-2-20	Factors Determining Use of Metal Bender
IL-2-21	Hand Seaming with Groovers
IL-2-22	Bend Allowances
IL-2-23	Care and Use of Chisels
IL-2-24	Care and Use of the Crimping Machine
IL-2-25	Rotary Machines; Types and Construction
IL-2-26	Factors Determining Selection of Proper Rotary Machine for the Job Required
IL-2-27	Care and Use of the Turning Machine
IL-2-28	Care and Use of the Burring Machine
IL-2-29	Care and Use of the Elbow Edger and Flanger
IL-2-30	Rivets
IL-2-31	Care and Use of the Hand "Pop" Rivet Gun
IL-2-32	Care and Use of the Squaring Shears
IL-2-33	Care and Use of the Slip Rolls
IL-2-34	Care and Use of the Lock Former
IL-2-35	Types of Metal Fasteners
IL-2-36	Care and Use of Files
IL-2-37	Care and Use of Bench Stakes
IL-2-38	Care and Use of the Hand Hack Saw

SKILL COMPETENCIES/OPERATIONS The student will be able to:	
SC-2-31	Flanging with Power Flanger
SC-2-32	Bending Metal with Handy Seamer
SC-2-33	Making Drive Cleats By Hand
SC-2-34	Making "S" Slip
SC-2-35	Shearing Circular Shapes on the Ring and Circle Shears
SC-2-36	Soldering a Seam with a Soldering Iron
SC-2-36A	Soft Soldering with Torch
SC-2-37	Forming Metal on Bench Stakes
SC-2-38	Filing Metal By Hand
SC-2-38A	Draw Filing
SC-2-39	Cutting with a Hack Saw
SC-2-40	Drilling Holes with Electric Hand Drill
SC-2-41	Tightening and Loosening Screws with Flat Screwdriver
SC-2-42	Bending Metal in Press Brake
SC-2-43	Using the Pedestal Grinder
SC-2-44	Drilling Holes in Metal on the Drill Press
SC-2-45	Smoothing and Shaping Metal Using File
SC-2-46	Cut Metal on the Band Saw
SC-2-47	Grinding Metal with Depressed Center Wheel

INFORMATION LESSONS	
IL-2-39	Use and Care of Hand Drills
IL-2-40	Drill Bits
IL-2-41	Care and Use of Screwdrivers
IL-2-42	Care and Use of the Grinders
IL-2-43	Grinders; Types and Construction
IL-2-44	Grinding Wheels; Types and Sizes
IL-2-45	Factors Determining Selection of Grinding Wheels
IL-2-46	Personal Safety in Using Grinders
IL-2-47	Personal Safety in Using the Drill Press
IL-2-48	Drill Press; Types and Construction
IL-2-49	Determining Proper Drill Speed
IL-2-50	Care and Use of Sheet Metal Hammers
IL-2-51	Band Saw; Types and Construction
IL-2-52	Factors Determining Blade Selection
IL-2-53	Factors Determining Sawing Speeds
IL-2-54	Care and Use of the Band Saw
IL-2-55	Care and Use of the Turret Punch
IL-2-56	Care and Use of the Iron Worker

SKILL COMPETENCIES/OPERATIONS The student will be able to:	
SC-2-48	Punching Holes in Metal on Turret Punch
SC-2-49	Using the Portable Disc Sander
SC-2-50	Shearing Metal with the Unishear
SC-2-51	Nibbling with Metal Worker
SC-2-52	Slotting with the Metal Worker
SC-2-53	Shearing with the Metal Worker
SC-2-54	Flanging with the Metal Worker
SC-2-55	Shrinking Metal Cold
SC-2-56	Stretching Metal Cold

INFORMATION LESSONS	
IL-2-57	Solders and Fluxes
IL-2-58	Bench Lever Shears; Types and Construction
IL-2-59	Types, Care and Use of Levels
IL-2-60	Use and Care of Hand Nibblers
IL-2-61	Types and Sizes of Hand Tongs
IL-2-62	Care and Use of Taps and Dies

UNIT III. WELDING

SKILL COMPETENCIES/OPERATIONS The student will be able to:	
SC-3-1	Transporting Acetylene and Oxygen Cylinders
SC-3-2	Setting Up Gas Welding Equipment
SC-3-3	Opening the Oxy-Acetylene Equipment for Welding
SC-3-4	Lighting and Adjusting the Torch and Flame
SC-3-5	Closing the Oxy-Acetylene Equipment
SC-3-6	Cleaning Cutting or Welding Tips with a Tip Cleaner
SC-3-7	Joining Metal by Fusion Welding without Filler Rod
SC-3-8	Joining Metal by Fusion Welding with Filler Rod
SC-3-9	Brazing
SC-3-10	Lighting and Adjusting the Prestolite Torch
SC-3-11	Attaching and Lighting a Cutting Torch
SC-3-12	Flamecutting with a Hand Torch
SC-3-13	Piercing Holes with a Cutting Torch
SC-3-14	Stretching Metal with Heat
SC-3-15	Shrinking Metal with Heat
SC-3-16	Strike an Arc and Run a Bead

INFORMATION LESSONS	
IL-3-1	Care and Use of Personal Equipment
IL-3-2	Safety - Personnel and Shop
IL-3-3	Oxygen and Acetylene Cylinders, Types and Sizes
IL-3-4	Proper Handling and Storage of Cylinders
IL-3-5	Safety - Protective Clothing
IL-3-6	Types and Sizes of Welding Machine
IL-3-7	Electrical and Welding Terms
IL-3-8	Types of Gas--Shielded Arc Processes
IL-3-9	Safety for Oxy-Acetylene Welding and Cutting
IL-3-10	Proper Methods for Connecting Oxy-Acetylene Equipment
IL-3-11	Types and Sizes of Torches
IL-3-12	Types and Sizes of Welding Tips
IL-3-13	Types and Sizes of Cutting Tips
IL-3-14	Proper Care of Torches and Tips
IL-3-15	Types and Sizes of Regulators
IL-3-16	Proper Care of Regulators
IL-3-17	Proper Methods for Leakage Detection
IL-3-18	Types and Sizes of Oxy-Acetylene Hose
IL-3-19	Proper Care of Oxy-Acetylene Hoses
IL-3-20	Safety; Prevention of Backfire and Flashback with Oxy-Acetylene Equipment

SKILL COMPETENCIES/OPERATIONS The student will be able to:	INFORMATION LESSONS	
	IL-3-21	Types of Welding Current
	IL-3-22	Techniques on Position Welding (1) Flat (2) Horizontal (3) Vertical Up (4) Vertical Down (5) Over Head
	IL-3-23	Types of Welded Joints
	IL-3-24	Methods of Pipe Welding
	IL-3-25	Methods of Joint Preparation
	IL-3-26	Preparation of Base Metals
	IL-3-27	Types and Sizes of Filler Rods
	IL-3-28	Types and Sizes of Electrodes and Holders
	IL-3-29	Types and Sizes of Cleaning Equipment: (1) Chipping Hammers (2) Wire Brushes
	IL-3-29	Types and Sizes of Cables and Ground Clamps
	IL-3-30	Electrode Selection
	IL-3-31	Electrode Classification; (1) A.W.S. (2) N.E.M.A.
	IL-3-32	Conserving and Storing Electrodes
	IL-3-33	Controlling Distortion--Warpage

UNIT IV. INSTALLATION AND REPAIR

SKILL COMPETENCIES/OPERATIONS The student will be able to:	
SC-4-1	Using a Caulking Gun
SC-4-2	Leveling
SC-4-3	Using the Hammer Drill
SC-4-4	Using the Water Level
SC-4-5	Threading Holes with a Tap
SC-4-6	Cutting External Threads with a Die
SC-4-7	Driving a Screw with an Electric Drill
SC-4-8	Cutting Metal with Electric Hand Nibbler
SC-4-9	Using a Line Level
SC-4-10	Cutting Holes in Metal with Sabre Saw
SC-4-11	Driving Nails with a Claw Hammer
SC-4-11A	Pulling Nails with the Claw Hammer
SC-4-12	Erect Tubular Scaffolding
SC-4-13	Install Strap Hanger on a Half Round Spout
SC-4-14	Erecting Extension Ladders
SC-4-15	Placing Ladder Jacks
SC-4-16	Cutting a Hole in a Masonry Wall with a Star Chisel
SC-4-17	Cutting Mortar Joints with Cape Chisel and Hammer
SC-4-18	Cutting Mortar Joints in Masonry Chimneys and Walls

INFORMATION LESSONS	
IL-4-1	Caulking and Roof Cements
IL-4-2	Types and Uses of Masonry Bits
IL-4-3	Types of Masonry Drills--Electric, Air, Rotating and Hammer
IL-4-4	Fastening Devices
IL-4-5	Climate and Its Effect on Metals
IL-4-6	Chain Hoist and Porta Hoists
IL-4-7	Types of Fans
IL-4-8	Adjusting Blower Belt Tension
IL-4-9	Metal Fatigue and Its Causes
IL-4-10	Care and Use of the Prestolite Torch
IL-4-11	Care and Use of the Portable Grinder
IL-4-12	Care and Use of the Unishears
IL-4-13	Fluxes and Their Effects on Metals
IL-4-14	Ferrous and Nonferrous Metal
IL-4-15	Working Safely with Dirty Metals
IL-4-16	Selection of Band Saw Blades
IL-4-17	Selection of Band Saw Cutting Speed
IL-4-18	Safety Procedures on Repair Work
IL-4-19	Care and Use of Tubular Scaffolding

SKILL COMPETENCIES/OPERATIONS The student will be able to:		INFORMATION LESSONS	
SC-4-19	Cutting Curves with a Compass Saw	IL-4-20	Care and Use of Wooden Ladders
SC-4-20	Using the Porta Hoist	IL-4-21	Care and Use of Wood Planking

WRITTEN INSTRUCTIONAL AIDS

Introduction

Instruction sheets are aids used in developing the most effective and efficient teaching-learning situation that is possible. Four types of sheets are generally used including job sheets, operation sheets, information sheets and assignment sheets.

JOB SHEETS indicate to the student what to do in performing the various jobs assigned by the instructor. The jobs that will be used as vehicles of instruction in the course are listed in the COURSE OUTLINE section.

The job involves a sequential performance of operations by the learner to "tryout" and develop the skill competencies (operations) of the occupation resulting in a product or service. It is the vehicle of instruction or the media by which the student practices and develops a series of skill competencies (operations).

OPERATION SHEETS supplement the job sheets and indicate to the student how to perform the many skill competency operations necessary to complete the assigned jobs. The operations that will be taught in the course are listed in the COURSE OUTLINE section under skill competencies/operations. The operation sheets should be numbered to correspond with the Skill Competencies listed in the course outline.

Operations are the subdivision in the breakdown of a job. Each operation represents a process, way of doing or how to perform the particular skill competency or operation.

INFORMATION SHEETS supplement the job sheets and provide the student with information necessary for completing the assigned jobs with highest possible degree of understanding. The information units that will be stressed in the course are listed in the course outline under information lessons. The information sheets included in the section should be numbered to correspond with the Information Lessons listed in the course outline.

ASSIGNMENT SHEETS supplement the job sheets and provide the student with mental activities necessary to learn the "knowing" that accompanies the "doing" of a trade. The student is assigned related studies or technical information to be "sought out" on an individual basis through the use of problems or "exercises". The Assignment Sheets should be numbered to correspond with the Information Lessons listed.

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-1-1

JOB: Fasten Paper to Board

UNIT I: Pattern Drafting and Layout

COURSE: Metal Fabrication

MATERIAL: Drawing Paper

EQUIPMENT: Drawing Board, Scissors, Thumbtacks, Pencil, T-Square

SAFETY PRECAUTIONS:

Handle drawing equipment carefully; it can easily be damaged.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Place drawing board on desk. (Largest side toward you)	. SC-1-1
2. Place drawing paper on board flush with left side and end nearest you.	
3. Use T-square to hold paper down.	
4. Insert a thumbtack in each corner of board.	
5. Mark and cut off any excess paper from the top and right side.	

METHOD OF EVALUATION:

Check placement of paper on board.

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-1-2

JOB: Square Paper

UNIT I: Pattern Drafting and Layout

COURSE: Metal Fabrication

MATERIAL: Drawing Paper

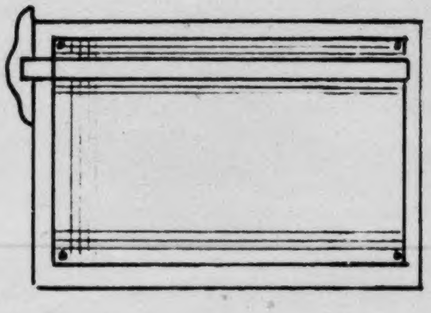
EQUIPMENT: T-Square
Drawing Board 45/90° Plastic Angle

TOOLS: Pencil

SAFETY PRECAUTIONS:

Use care while handling drawing equipment.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Place paper on drawing board.	
2. Near top and bottom edge of paper draw horizontal lines across the entire length of the paper.	
3. Holding the head of the T-square on top of the board, draw lines on left and right side of paper perpendicular to the first two lines.	. SC-1-1 and SC-1-2
4. Check all corners to be sure they are 90° angles.	



METHOD OF EVALUATION:

Check work for squareness.

JOB: Draw Parallel (Vertical and Horizontal Lines)

JOB SHEET IDENTIFICATION CODE

UNIT I: Pattern Drafting and Layout

JOB NUMBER: J-1-3

COURSE: Metal Fabrication

MATERIAL: Drawing Paper

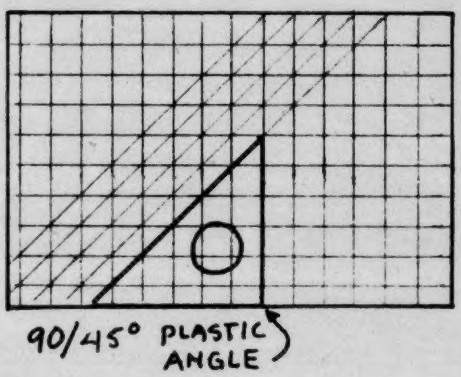
EQUIPMENT: Drawing Board, T-Square, Plastic Angles, Thumbtacks, Rule

TOOLS: Pencil

SAFETY PRECAUTIONS:

Drawing equipment must be handled with great care.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Measure a series of 1" spaces from the bottom to the top of the drawing paper.	. SC-1-1, SC-1-2, SC-1-3
2. Holding the edge of the Tee on each mark, draw thin even lines completely across the board.	
3. Measure 1" spaces across the paper from left to right.	
4. Draw thin even lines vertically through these marks. Use the plastic angle to draw these lines.	
5. From the base of each 1" square using the 90/45⁰ angle draw 45⁰ angle lines through each square.	
6. Check for accuracy.	



METHOD OF EVALUATION:

1. Check accuracy and placement of lines.
2. Check proper tool usage.

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-1-4

JOB: Draw Circles

UNIT I: Pattern Drafting and Layout

COURSE: Metal Fabrication

MATERIAL: Paper

EQUIPMENT: Drawing Board
Thumbtacks

TOOLS: Pencil
Compass
Rule

SAFETY PRECAUTIONS:

Do not prick yourself with sharp point of compass.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Use the rule to mark off a 1", 2", 3", 4" and 5" line.	. SC-1-1
2. Find the center of each line.	. SC-1-4 & 5
3. Adjust the compass from the end of each line to the center point.	
4. Scribe the desired circle on each line.	
5. Measure for accuracy.	

METHOD OF EVALUATION:

1. Check accuracy of work.
2. Check proper tool usage.

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-1-5

JOB: Draw Polygons

UNIT I: Pattern Drafting and Layout

COURSE: Metal Fabrication

MATERIAL: Paper

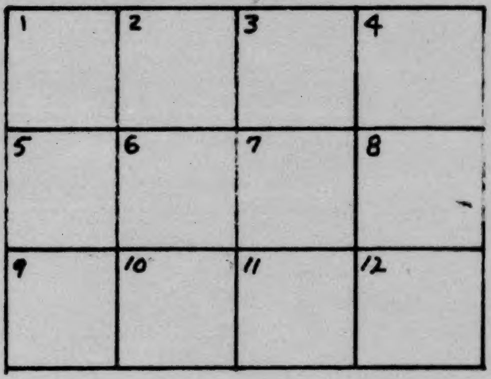
EQUIPMENT: Board, T-Square
Angles, Thumbtacks

TOOLS: Drawing Tools
Pencil
Eraser

SAFETY PRECAUTIONS:

Handle precision instruments with care, do not drop, or poke sharp points into desks or people.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Divide the drawing paper into (12) four and one half inch blocks.	. SC-1-1 thru SC-1-5
2. Number the blocks from 1 to 12.	
3. Draw a triangle in block #1.	
4. Draw a rectangle in block #2.	
5. Draw a square in block #3.	
6. Draw a pentagon in block #4.	
7. Draw a hexagon in block #5.	
8. Draw a septagon in block #6.	
9. Draw an octagon in block #7.	



METHOD OF EVALUATION:

Check the accuracy of the work.

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-1-6

JOB: Geometrical Drawings

UNIT I: Pattern Drafting and Layout

COURSE: Metal Fabrication

MATERIAL: Paper

EQUIPMENT: Drawing Board, T - Square, Angles, Thumbtacks

TOOLS:
Drawing Tools
Rule
Pencil

SAFETY PRECAUTIONS:

Observe the standard safety procedures used with drafting equipment.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Divide drawing paper into 12 equal spaces. Number from 1 to 12.	. SC-1-1 thru SC-1-5
2. Using Daugherty's Sheet Metal Layout Pattern Book, draw the first 12 Geometric Figures using the step by step procedures as shown.	
3. Divide second paper into 12 equal spaces. Number from 13 to 24.	
4. Draw figures 13 to 24 again using step by step procedures.	
5. Divide third drawing paper into 12 equal spaces. Number from 25 to 36.	
6. Draw figures 25 to 36 as shown.	

1	2	3	4
5	6	7	8
9	10	11	12

METHOD OF EVALUATION:

Check the accuracy of the work.

JOB: Drawing to Scale

UNIT I: Pattern Drafting and Layout

COURSE: Metal Fabrication

MATERIAL: Paper

EQUIPMENT: Drawing Board, T-Square, Plastic Angles, Thumbtacks

TOOLS: Architect's Rule
Drawing Tools

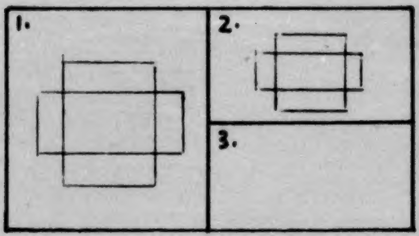
JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-1-7

SAFETY PRECAUTIONS:

Do not hammer the edges of the rule, handle the sharp pointed drawing instruments carefully.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Fasten drawing paper to drawing board and divide into 3 spaces as shown in sketch.	
2. Using the 3" scale layout exactly to scale a pan that measures 24" X 24" X 6" high. Do this in block #1.	. SC-1-1 thru SC-1-5 & SC-1-7
3. Using the 1½" scale layout this pan again in block #2.	
4. Using the 3/4" scale layout this pan again in block #3.	
5. Do not use any dimensions on your drawings.	



METHOD OF EVALUATION:

Check for proper scale of work.

JOB: One Piece Box

UNIT I: Pattern Drafting and Layout

COURSE: Metal Fabrication

MATERIAL: Paper

EQUIPMENT: Drawing Board, Tee Square, Angles, Tacks

TOOLS: Drawing Tools
Pencil
Eraser

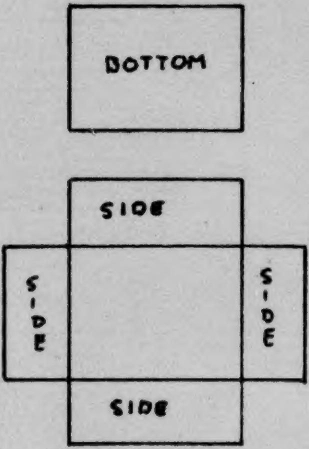
JOB SHEET IDENTIFICATION CODE

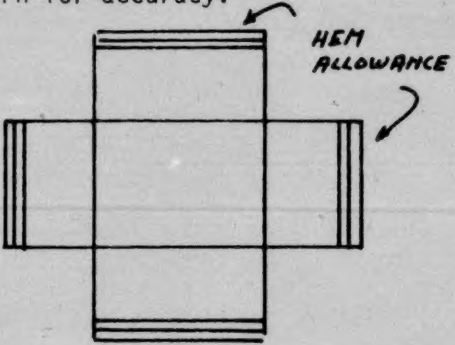
JOB NUMBER: J-1-8

SAFETY PRECAUTIONS:

Handle with care all sharp pointed instruments.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Box measurements 8" long, 6" wide, 3" high, with ¼" double hem on 4 sides.	. SC-1-1 thru SC-1-5
2. Layout the bottom.	
3. Layout the four sides.	
4. Add necessary allowance for a double hem on all four sides.	
5. Check pattern for accuracy.	





METHOD OF EVALUATION:

1. Check the pattern for accuracy.
2. Check for proper pattern spacing.

JOB: Flat Duct Elbow

UNIT I: Pattern Drafting and Layout

COURSE: Metal Fabrication

MATERIAL: Paper

EQUIPMENT: Drawing Board
Tee Square
Angles

TOOLS: Drawing Tools Pencil
Trammel Points Erasers

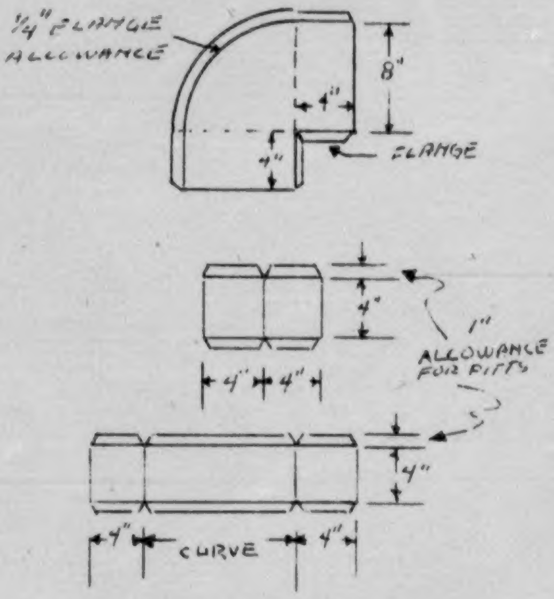
JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-1-9

SAFETY PRECAUTIONS:

Handle all sharp pointed instruments in a safe manner.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Flat duct elbow 8" X 4" with square throat, curved heel, throat legs to be 4" allow for pittsburgh lock seams.	. SC-1-1 thru SC-1-5
2. Layout the (cheeks) or top and bottom to given measurements.	
3. Layout wrappers (heel and throat), calculate heel length (mathematically).	
4. Allow material needed to make pittsburgh lock.	
5. Allow material necessary to turn flanges that fit into pittsburgh lock.	
6. Recheck all measurements for accuracy.	



METHOD OF EVALUATION:

1. Check the pattern for accuracy.
2. Check proper pattern nesting

JOB: Layout an 8" Two Piece 45° Flue Pipe Elbow

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-1-10

UNIT I: Pattern Drafting and Layout

COURSE: Metal Fabrication

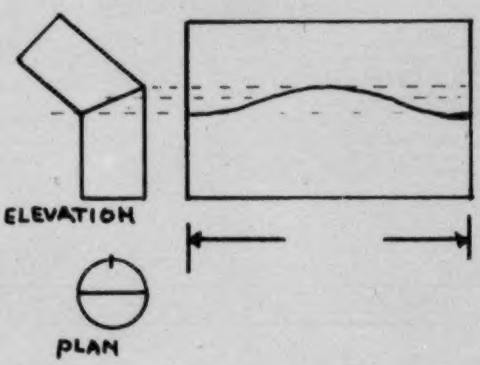
MATERIAL: Paper

EQUIPMENT: Drawing Board, Tee Square, Plastic Angles, Tacks

TOOLS:
- Drawing Tools
- Pencil
- Eraser

SAFETY PRECAUTIONS:

All students have the responsibility of handling sharp instruments carefully.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Layout pattern for an 8" diameter flue pipe elbow, 2 pieces at 45° throat legs are 3" long.	NOTE: Allow for ¼" grooved seam on pieces and 1/8" tight seam on miter joints. . SC-1-1 thru SC-1-5
2. Layout plan.	
3. Layout elevation.	
4. Project elbow stretchout from elevation.	
5. Check stretchout length mathematically.	
6. Allow for seams and edges.	
7. Check miter line and complete pattern for accuracy.	

METHOD OF EVALUATION:

1. Check for correct pattern layout.
2. Check the computations made.

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-2-1

JOB: Find a Piece of Metal 3" X 7"

UNIT II: Fabrication

COURSE: Metal Fabrication

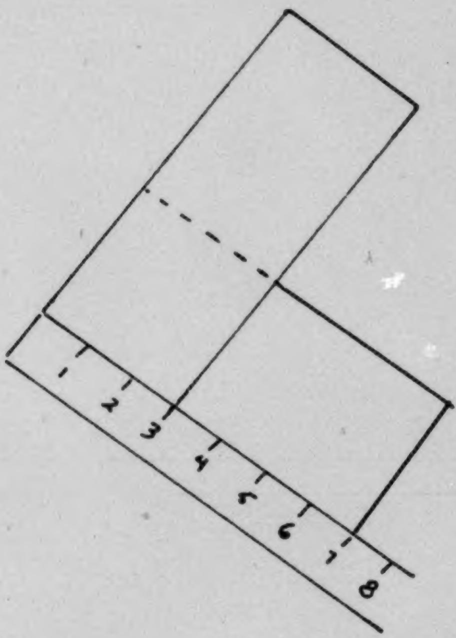
MATERIAL: Various Sized Pieces of Steel, some of which are 3" X 7"

TOOLS: Bench Rule

SAFETY PRECAUTIONS:

Do not get cut on sharp edges of metal.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Using bench rule sort through various sized pieces of steel until you find a piece 3" X 7".	



METHOD OF EVALUATION:

1. Check selected metal for proper size.
2. Check for correct measuring technique.

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-2-2

JOB: Lay Out a Single Hem

UNIT II: Fabrication

COURSE: Metal Fabrication

MATERIAL: (2) Pcs-26 Gage Steel 3" X 7"

TOOLS: Scribe
Bench Rule

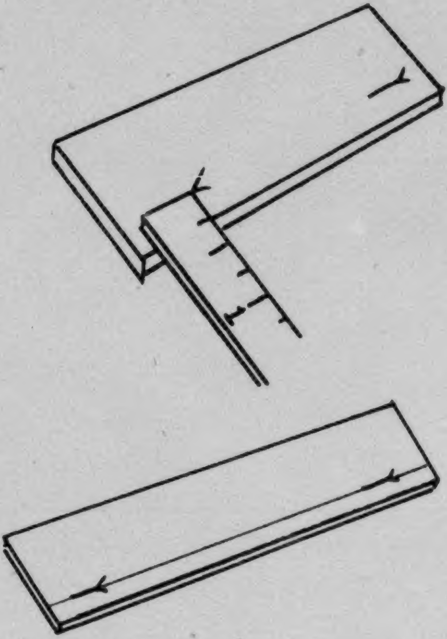
SAFETY PRECAUTIONS:

Be careful handling thin steel sheets, do not get cut on sharp edges.

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

1. Place rule on piece of steel so that the ¼" mark is even with the edge of the piece.
2. Using the scribe mark the work piece at the end of the rule. —<
3. Repeat procedure near the other end of the work piece.
4. Using the edge of the bench rule and the scribe, scribe a line the length of the work piece that passes through the exact center of the marks.
5. Using another piece of metal, repeat steps 1 through 4 so that two identical pieces are produced.



METHOD OF EVALUATION:

Work pieces should be 3" X 7" with a line the full length of the work piece ¼" from the edge. Line should pass exactly through marks —< as this —<—.

JOB: Bend Single Hem

UNIT II: Fabrication

COURSE: Metal Fabrication

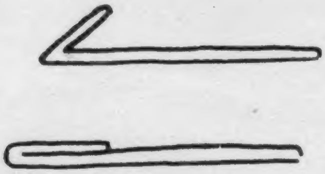
MATERIAL: 26 Gage Galvanized Steel with Bend Line ¼" from Edge as in Job #2

EQUIPMENT: Cornice Brake

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-2-3

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Place piece in brake to bend line and bend as far as brake will go. (Approx. 135°)	. SC-2-11
2. Place bent edge under upper blade of brake and squeeze flat finishing single hem.	



METHOD OF EVALUATION:

1. Check the hem for tightness.
2. Check for accuracy of bend.
3. Check for proper bending technique on cornice brake.

JOB: Bend a Double Hem

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-2-4

UNIT II: Fabrication

COURSE: Metal Fabrication

MATERIAL: (1) Pc of 26 Gage Galvanized Steel Larger than 3" X 7"

EQUIPMENT: Cornice Brake

TOOLS:
Scribe
Bench Rule
Straight Snips

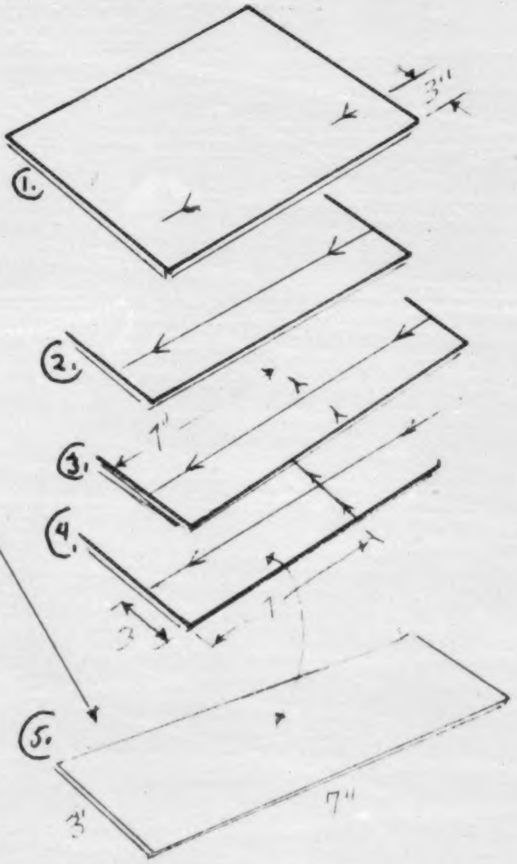
SAFETY PRECAUTIONS:

1. Be careful to avoid pinching fingers in brake.
2. Be careful not to hit anyone with counterbalances while operating brake.

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

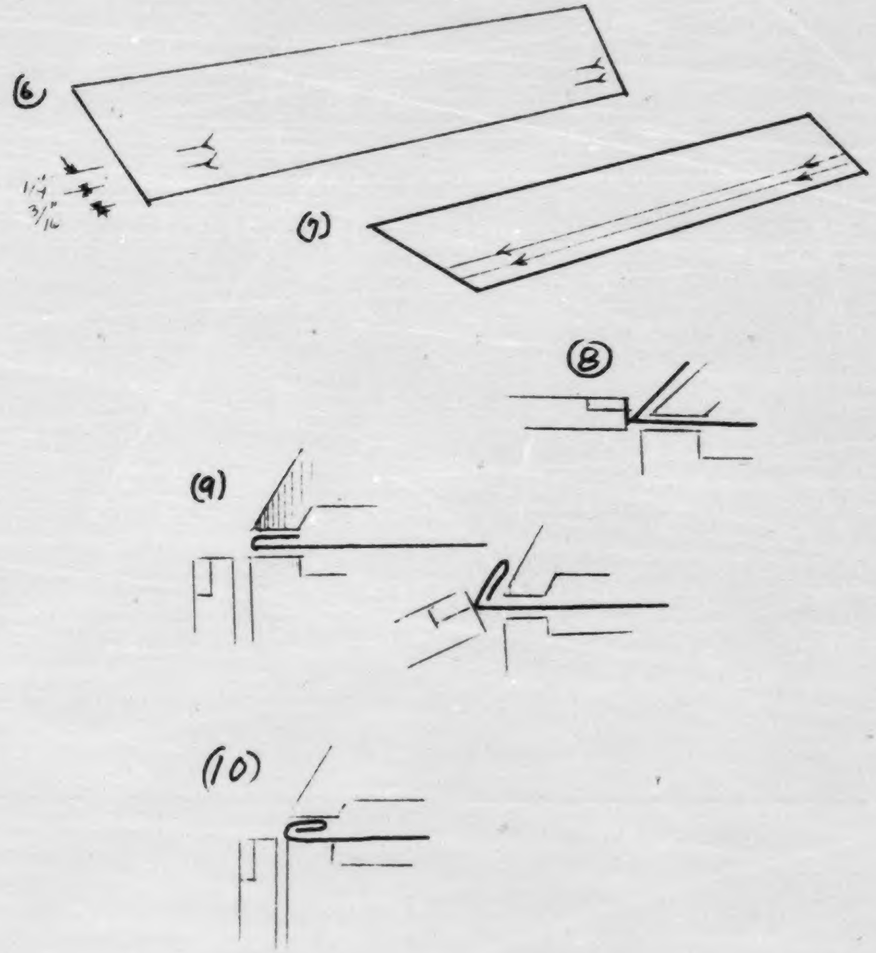
TEACHING/LEARNING ACTIVITIES

1. Measure in from side of piece of metal 3" and mark with scribe, two places.
2. With bench rule, scribe a straight line between marks.
3. Measure in from end of metal 7" and mark with scribe, two places.
4. With bench rule scribe a line between marks.
5. Using straight tin snips cut out the 3" X 7" rectangle. When finishing a cut at the corner place the tip of the shear blades at the end of the cut.
6. Measure and mark bend lines in from the side of the metal 3/16" and 1/4" at each end.
7. Scribe straight lines between marks.
8. Place outside (3/16) line under upper leaf of cornice brake and bend as far as it will go.
9. Squeeze 3/16 edge flat and place clamping leaf on 1/4" edge then bend it as far as the brake will go.



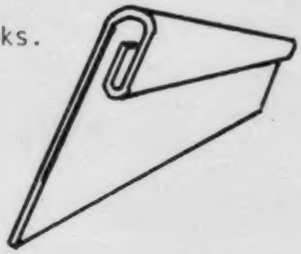
NOTE: Pictures for steps 6 through 10 are on the back of this sheet.

10. Finish double hem by clamping edge in brake to squeeze it flat.



METHOD OF EVALUATION:

1. Inspection should reveal one piece of metal 7" long 2-9/16" wide with edge bent as illustrated.
2. Edges should be free of sharp burrs and fish hooks.



JOB: Make a One Piece Box

UNIT II: Fabrication

COURSE: Metal Fabrication

MATERIAL: Pattern of a One Piece Box Developed in Pattern Drafting

EQUIPMENT: Cornice Brake
Notcher

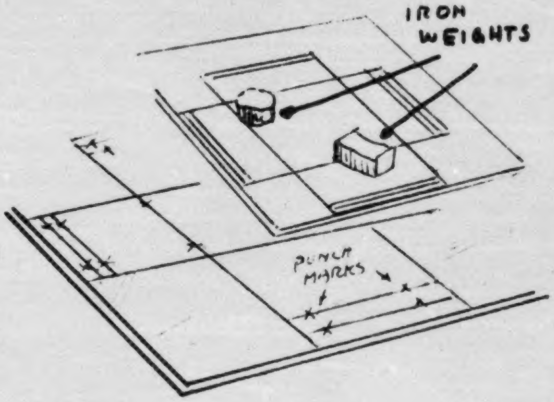
TOOLS: Straight Snips, Bench Rule, Scribe, Weights, Prick Punch

JOB SHEET
IDENTIFICATION CODE

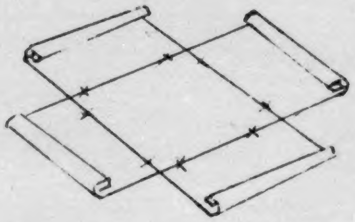
JOB NUMBER: J-2-5

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

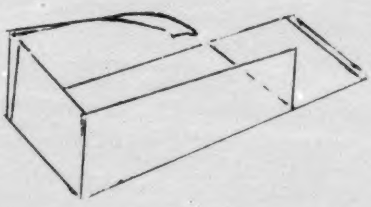
1. Place pattern on metal and hold it in place with iron weights.
2. Place bench rule on paper to aid in scribing a straight line along edges of paper and scribe the outline of the paper pattern on the steel.
3. Prick punch each bend line about ¼" from each end.
4. Cut out outside edges of pattern (do not cut corners out) with straight snips.



5. Place corner in notcher so that both sides of the angle on the pattern are directly under cutting edge. Pull down operating handle, cutting out a 90° notch. Repeat on other 3 corners.
6. Bend double hem on all four sides.
7. Bend up 3 sides of box starting with one long side first.



8. Fourth side will only bend up about 45° until sides hit clamping leaf of brake - bend one corner in (with other corner past end of brake) last side can be bent.
9. Straighten out bent edge clamp in brake to help straighten.



METHOD OF EVALUATION:

1. Box should be smooth without fish hooks or tool marks.
2. Top edges of sides should be even at the same height.

JOB: Make a Grooved Seam

UNIT II: Fabrication

COURSE: Metal Fabrication

MATERIAL: 26 Gage Galvanized Steel

EQUIPMENT: Bar Folder

TOOLS: Bench Rule, Straight Shears, Scribe, Groover, Setting Hammer, Rawhide Mallet

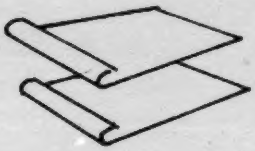
JOB SHEET
IDENTIFICATION CODE

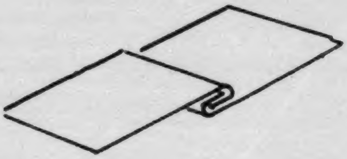
JOB NUMBER: J-2-6

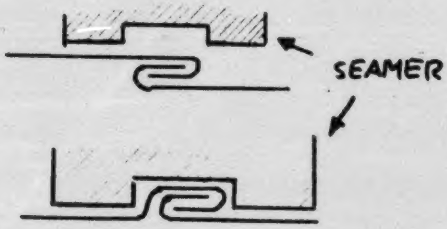
COMPETENCE - PROCEDURE/STEPS
The student will be able to:

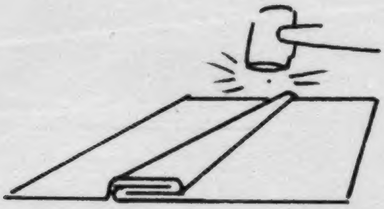
TEACHING/LEARNING ACTIVITIES

1. Mark out and cut two pieces of 26 gage galvanized steel 3" X 7".
2. Set gage of bar folder at ¼".
3. Insert edge of work piece in bar folder and bend to 180°. Repeat with second piece.
4. Turn one piece over and hook pieces together.
5. Set grooved seam with seamer.
6. After grooving is finished set seam down with a mallet. Hold mallet face flat to make seam smooth and tight.









METHOD OF EVALUATION:

1. Proper tightness of seam.
2. There should be no seamer marks on top of seam.
3. The seam should be flush on the bottom.

JOB: Make a Pan

UNIT II: Fabrication

COURSE: Metal Fabrication

MATERIAL: 26 Gage Galvanized Steel

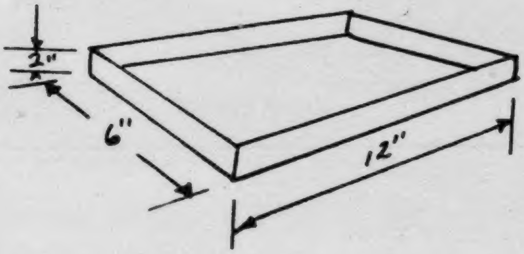
EQUIPMENT: Notcher
Bar Folder
Box and Pan Brake

TOOLS: Rule, Scribe, Prick Punch, Straight Snips

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-2-7

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Lay out a one piece pan 6" X 12" X 2" with a ¼" single hem on top edge turned to the inside.	. SC-1-1 . SC-2-2
2. Prick punch bend lines.	. SC-2-4
3. Cut out metal with straight snips.	. SC-2-5
4. Notch corners with notcher.	. SC-2-6
5. Bend single hem on bar folder.	. SC-2-7
6. Bend sides on box and pan brake.	. SC-2-9



METHOD OF EVALUATION:

1. Check the height of each side of the box at the corners.
2. Check for overall accuracy.
3. Check for flushness of corner joints.

JOB: Make a Metal Disc

UNIT II: Fabrication

COURSE: Metal Fabrication

MATERIAL: 12" Square Piece of 26 Gage Galvanized Steel

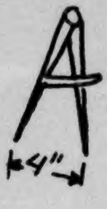
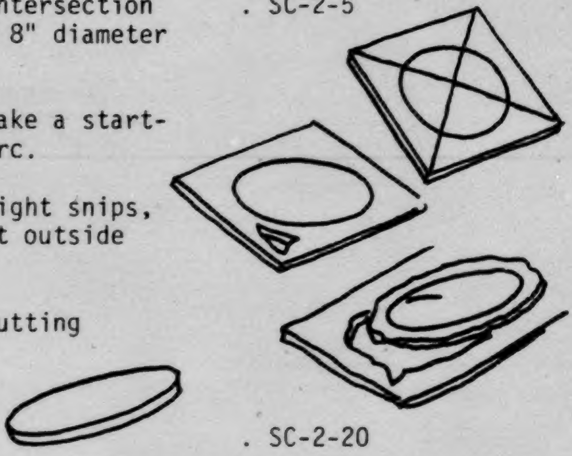
TOOLS:
Bench Rule
Combination Shears
Chisel and Hammer

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-2-8

SAFETY PRECAUTIONS:

Be careful not to get cut on sharp edges of metal.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Using bench rule and dividers, set dividers to a radius of 4".	. SC-1-1 
2. Using bench rule as a straight edge, draw lines with scribe through opposite corners of 12" square sheet of metal.	
3. Place one leg of dividers on intersection of those two lines and draw an 8" diameter circle.	. SC-2-5
4. Using hammer and cold chisel make a starting slot just outside of the arc.	
5. Using combination pattern straight snips, cut out the circle keeping just outside of the arc.	
6. Make a final cut around disc cutting exactly on the line.	. SC-2-20

METHOD OF EVALUATION:

Circle should be 8" diameter and smooth on the edge without fish hooks.

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-2-9

JOB: Shear with Chisel on Vise

UNIT II: Fabrication

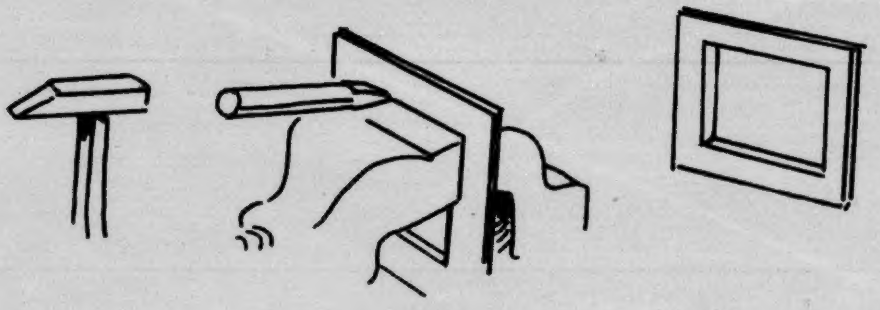
COURSE: Metal Fabrication

MATERIAL: 26 Gage Galvanized Steel

EQUIPMENT: Bench Vise

TOOLS: Cold Chisel
Hammer

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Scribe a 6" square on 26 gage galvanized steel.	. SC-1-1 and SC-2-2
2. Cut out square with straight snips.	. SC-2-5
3. Scribe a 4" square in center of 6" square.	. SC-1-1, SC-2-2
4. Cut 4" center square out leaving the 1" perimeter intact using a hammer and cold chisel.	. SC-2-11



METHOD OF EVALUATION:

1. Check smoothness of cut.
2. Check chiseling techniques.

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-2-10

JOB: Cut Round Hole in Square Plate

UNIT II: Fabrication

COURSE: Metal Fabrication

MATERIAL: 26 Gage Galvanized Steel

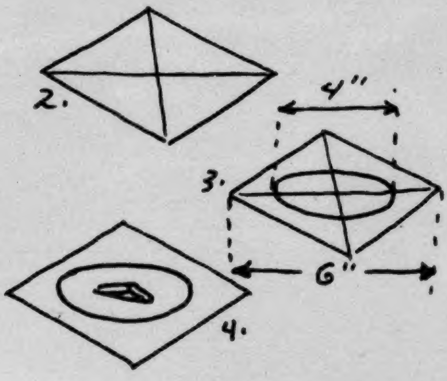
TOOLS:
Hammer
Chisel
Aviation Shears
Straight Shears
Dividers
Scribe
Rule

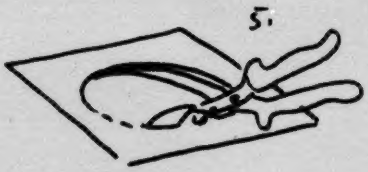
SAFETY PRECAUTIONS:

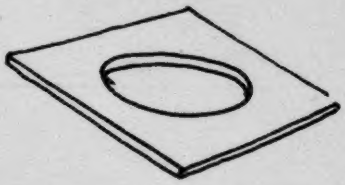
Wear safety glasses.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

1. Measure and mark a 6" square piece of 26 gage galvanized steel and cut out with straight snips.
2. Use scribe and straight edge to locate center of 6" square. Prick punch center.
3. Set dividers to 2" radius and mark a 4" circle on 6" square piece of steel.
4. Use hammer and chisel to cut a starting slot in center of circle.
5. Use aviation snips to cut out circle first time around, keep in ¼" from circle, then last time cut smoothly on the line.







METHOD OF EVALUATION:

Six inch square of 26 gage galvanized steel with a smooth round 4" diameter hole in the center - no irregular cuts or fish hooks.

JOB: Make a Standing Seam

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-2-11

UNIT II: Fabrication

COURSE: Metal Fabrication

MATERIAL: 26 Gage Galvanized Steel

EQUIPMENT: Foot Squaring Shear
Cornice Brake

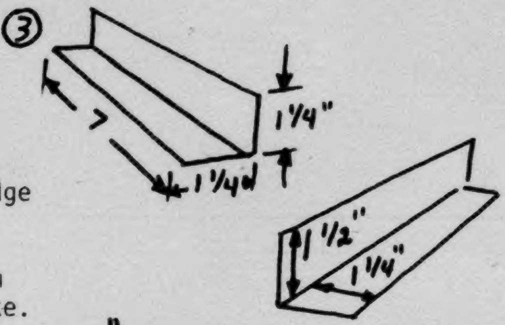
TOOLS: Rule
Scribe
Marking Gage

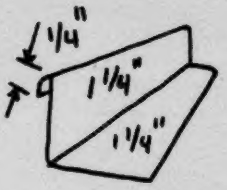
SAFETY PRECAUTIONS:

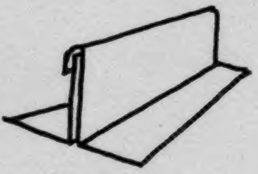
1. Keep fingers away from shear.
2. Allow scrap to fall to floor, don't hold fingers behind shear while operating.
3. Keep feet out from under treadle.

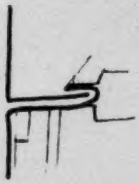
COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

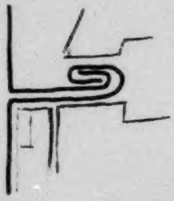
1. Measure and mark out:
   (1) Pc 26 gage steel 2½" X 7"
   (1) Pc 26 gage steel 2-3/4" X 7"
2. Cut pieces on foot squaring shear.
3. Mark narrow piece (2½ X 7) 1¼" from edge and bend 90° in cornice brake.
4. Mark wider piece (2-3/4 X 7) 1¼" from one edge and bend 90° in cornice brake.
5. Get (or make) a marking gage to mark a bend line ¼" from edge of wide piece on wide flange.
6. Bend ¼" edge 180° in cornice brake.
7. Place pieces together.
8. Put pieces in cornice brake so that the ¼" seam is in brake and bend as far as possible.
9. Put seam in cornice brake and clamp down to finish standing seam.











METHOD OF EVALUATION:

1. Seam should be about 1" high and 7" long.
2. Seam should be tight enough to keep from slipping apart.

JOB:	Fabricate a Cylindrical Pipe	JOB SHEET IDENTIFICATION CODE
UNIT II:	Fabrication	JOB NUMBER: J-2-12
COURSE:	Metal Fabrication	
MATERIAL:	26 Gage Galvanized Steel	
EQUIPMENT:	Slip Roll Former Foot Squaring Shear	Bar Folder Lockformer with Pipelock Rolls
TOOLS:	Bench Rule Hollow Mandrel Stake	Scribe Mallet

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Lay out a 24" long piece of 6" diameter round pipe 24" X 19-7/8" (24" long by circumference of 6" circle = 18-7/8" + ½" each side for seam allowance). Cut with foot shear.	
2. Run pipe lock on both edges - be sure you turn the sheet over after the first edge is turned - before the second edge is turned.	
3. Roll metal in slip roll former. Be sure seam is parallel with rolls.	
4. Hook seam together - put on hollow mandrel stake and set down with rawhide mallet.	

METHOD OF EVALUATION:

Check pipe for roundness especially at each side of the seam.

JOB: Cut Cylindrical Pipe in Two with Double Cutting Shears

JOB SHEET IDENTIFICATION CODE

UNIT II: Fabrication

JOB NUMBER: J-2-13

COURSE: Metal Fabrication

MATERIAL: Piece of Pipe Fabricated in Job #10

TOOLS: Double Cutting Shears

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Measure in from one end of the pipe 12", repeat about every 2" around pipe.	
2. Cut on line with double cutting shears.	

METHOD OF EVALUATION:

1. Check for smoothness of cut, there should be no fish hooks or kinks in pipe.
2. Check to be sure cut was made on the line.

JOB:	Crimp and Bead Two Pieces of Cylindrical Pipe	JOB SHEET IDENTIFICATION CODE
UNIT II:	Fabrication	JOB NUMBER: J-2-14
COURSE:	Metal Fabrication	
MATERIAL:	Two Pieces of 6" Pipe Fabricated in Job #10 and cut in Job #11	
EQUIPMENT:	Combination Rotary Machine Crimping Rolls Beading Rolls	

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Put pipe in crimping machine and crimp one end - repeat with other pipe.	
2. Put crimped end of pipe in beading rolls and bead pipe. Repeat with other pipe.	

METHOD OF EVALUATION:

1. Check the depth of crimp.
2. Check the depth of bead.
3. Do the pipes fit together?

JOB: Burr End of Pipe

UNIT II: Fabrication

COURSE: Metal Fabrication

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-2-15

MATERIAL: Pipe Previously Fabricated in Job #12. Cut in Job #13, then Crimped and Beaded in Job #14

EQUIPMENT: Turning Machine Fitting with Burring Rolls

TOOLS: Rule

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Set gage on turning machine to 3/16".	. SC-1-1
2. Burr an edge 3/16" wide on the end of the pipe.	. SC-2-21

METHOD OF EVALUATION:

1. Check burr for accuracy.
2. Check for smoothness of burred edge, there should be no kinks.

JOB: Eight Inch Two Piece 45° Flue Pipe Elbow

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-2-16

UNIT II: Fabrication

COURSE: Metal Fabrication

MATERIAL: 26 Gage Galvanized Steel
Paper Pattern Developed in Pattern Drafting Unit J-1-10

EQUIPMENT: Bar Folder
Foot Squaring Shear
Slip Roll Former
Turning Machine with Crimping Rolls
Turning Machine with Elbow Edging Rolls

TOOLS: Rule
Scribe
Prick Punch
Straight Snips
Hand Groover
Aviation Snips

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Apply paper pattern to metal using weights and scribe and straight edge, then prick punch bend lines and center element on each piece.	. SC-1-1, SC-2-2, SC-2-4
2. Cut out outline of pattern on squaring shear.	. SC-2-14
3. Cut out various pieces using straight snips and aviation shears as required.	. SC-2-10, SC-2-13, SC-2-5, SC-2-12
4. Turn single lock seam allowance on bar folder.	. SC-2-7
5. Roll pieces into circle with slip roll former, be sure prick punch marks are all the same way.	. SC-2-16
6. Groove seams with hand groover.	. SC-2-8
7. Crimp one end piece.	. SC-2-19
8. Join pieces together with elbow edging rolls.	. SC-2-22

METHOD OF EVALUATION:

Check the fit of the completed elbow.

JOB: Fabricate a Round Pipe with Riveted Lap Seam

JOB SHEET
IDENTIFICATION CODE

UNIT II: Fabrication

JOB NUMBER: J-2-17

COURSE: Metal Fabrication

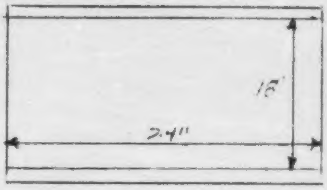
MATERIAL: 24 Gage Galvanized Steel
(12) 1½ lb. Tinners' Rivets

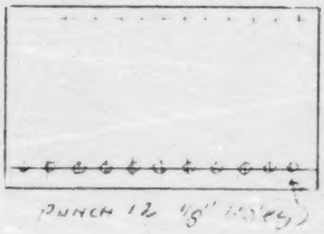
EQUIPMENT: Slip Roll Former
Crimping Machine

TOOLS: Rule
Scribe
Rivet Set
Marking Gage
Riveting Hammer
Hand Punch
Prick Punch

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

1. Layout a 24" long piece of 6" round pipe 24" X 19-7/8", on each side for seam allowance mark ½" from edge with marking gage.
2. Cut out with squaring shear.
3. Mark out rivet pattern along seam line spacing the first mark 1" from the edge and allowing 2" between marks.
4. Prick punch marks.
5. Using the hand punch fitted with a 1/8" punch and die - punch all holes (12 holes on each line).
6. Roll in slip roll former.
7. Rivet seam starting in the center and working toward both ends on hollow mandrel stake.





METHOD OF EVALUATION:

1. Check seam for smoothness there should be no buckles in the metal between the rivets.
2. Check the seam for layout accuracy.

JOB: Fabricate a Heavy Gage Round Pipe with Riveted Lap Seam

JOB SHEET IDENTIFICATION CODE

UNIT II: Fabrication

JOB NUMBER: J-2-18

COURSE: Metal Fabrication

MATERIAL: 16 Gage Galvanized Steel
(18) 4 lb. Tinners' Rivets

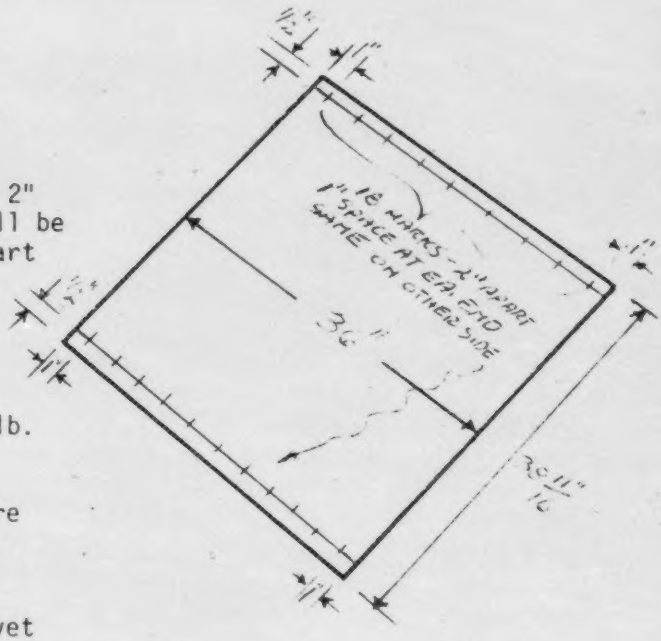
TOOLS:
Rule
Scribe
Marking Gage
Hand Punch
Prick Punch
Riveting Hammer
Rivet Set

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

---

1. Lay out a 36" joint of 12" diameter pipe 36" X 38-11/16".
2. Cut out workpiece on power shear.
3. Use marking gage to mark ½" from two edges for seam allowance.
4. Mark 1" from end of rivet line, then 2" along rest of line, so that there will be 18 holes on each edge of sheet 2" apart with one inch spacing to each end of sheet.
5. Prick punch marks.
6. Using hand punch, punch holes for 4 lb. rivets.
7. Use power rolls to roll pipe. Be sure rivet line is parallel to rolls when rolling.
8. Place on hollow mandrel stake and rivet seam starting with center rivet first.



METHOD OF EVALUATION:

Check overall appearance of the job.

JOB: Fabricate a Duct with a Pittsburgh Lock

JOB SHEET
IDENTIFICATION CODE

UNIT II: Fabrication

JOB NUMBER: J-2-19

COURSE: Metal Fabrication

MATERIAL: 26 Gage Galvanized Steel

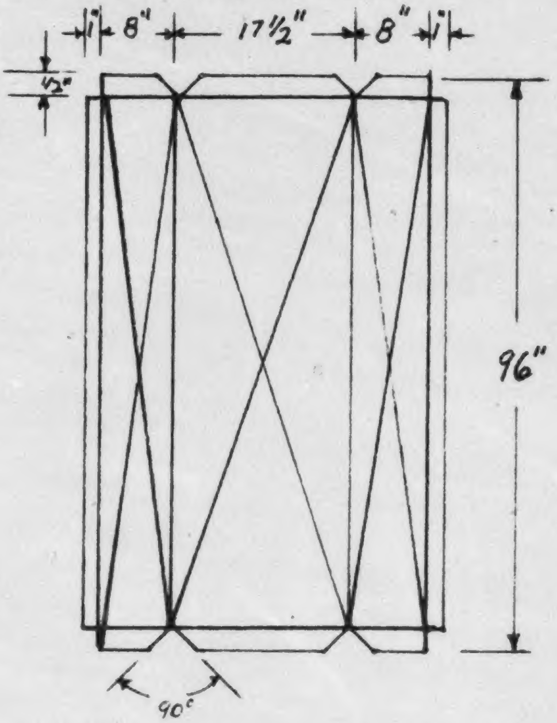
EQUIPMENT: Cornice Brake, Lockformer, Notcher, Power Shear

TOOLS: Rule, Scribe, Marking Gage, Hammer

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

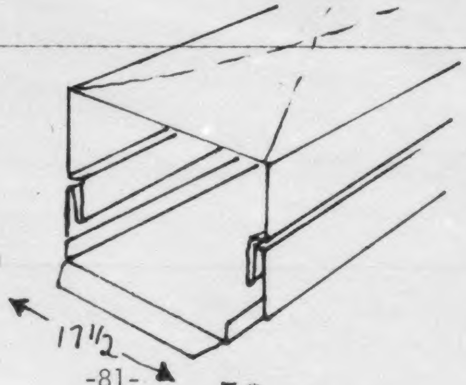
TEACHING/LEARNING ACTIVITIES

1. Lay out one 8' long joint of rectangular duct 8" X 17½" making the top and two sides in one piece.
2. Notch out corners and at bend lines.
3. Put in cornice brake with inside up and cross brake sides.
4. With inside up run both sides through lockformer - be sure to keep edge of sheet against guides tightly.
5. Put in cornice brake and bend 90⁰ at corners to get this.
6. Layout bottom.
7. Cut out with power shear.
8. Cross brake and bend ¼" edges 90⁰.
9. Assemble bottom on pipe with pittsburgh lock.



METHOD OF EVALUATION:

1. Check job for overall accuracy.
2. Check setting down of Pittsburgh seam.
3. Check crossbuckle depth and placement.



JOB: Flat Duct Elbow

UNIT II: Fabrication

COURSE: Metal Fabrication

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-2-20

MATERIAL: 26 Gage Galvanized Steel
Pattern for Flat Elbow from Unit on Pattern Drafting

EQUIPMENT: Cornice Brake
Notcher
Bar Folder
Lockformer
Easy Edger
Squaring Shear
Slip Roll Former

TOOLS: Rule
Scribe
Prick Punch
Hammer
Straight Snips
Marking Gage

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Apply paper pattern to 26 gage galvanized steel, hold paper in place with weights.	
2. Scribe around paper pattern and prick punch bend lines.	. SC-1-1, SC-2-2, SC-2-4
3. Cut all straight cuts with squaring shear.	. SC-2-14
4. Cut all curved cuts with straight snips.	. SC-2-5
5. Notch corners of heel and throat pieces.	. SC-2-6
6. Run heel and throat sections through lock former.	. SC-2-28
7. Turn edges for drive clips on bar folder.	. SC-2-7
8. Roll heel and throat sections in slip roll former.	. SC-2-16
9. Flange cheek pieces in easy edger.	. SC-2-30

METHOD OF EVALUATION:

Check the job for overall accuracy and appearance.

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-2-21

JOB: Heavy Flat Duct Elbow

UNIT II: Fabrication

COURSE: Metal Fabrication

MATERIAL: 20 Gage Galvanized Steel
Pattern from Unit in Pattern Drafting

EQUIPMENT:			
	Notcher		
	Bar Folder	Lockformer	Power Squaring Shear
	Power Edger	Cornice Brake	Slip Roll Former
TOOLS:	Rule	Prick Punch	Aviation Snips
	Scribe	Hammer	Marking Gage

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Apply paper pattern to 20 gage galvanized steel. Hold paper in place with steel weights, scribe lines around edge and prick punch bend line.	. SC-1-1, SC-2-2, SC-2-4
2. Cut out straight lines with power shear.	. SC-2-26
3. Notch corners of heel and throat pieces.	. SC-2-6
4. Run heel and throat pieces through lockformer.	. SC-2-28
5. Turn edges for drive clips in bar folder.	. SC-2-7
6. Roll curvature of heel in power rolls.	. SC-2-27
7. Cut curved part of cheek with aviation snips.	. SC-2-12
8. Flange cheek parts in power edger.	. SC-2-31
9. Assemble pittsburgh lock.	. SC-2-29

METHOD OF EVALUATION:

Check the job for overall accuracy and appearance.

JOB: Fabricate and Install Slips and Drive Clips

JOB SHEET IDENTIFICATION CODE

UNIT II: Fabrication

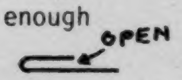
JOB NUMBER: J-2-22

COURSE: Metal Fabrication

MATERIAL: 22 Gage Galvanized Steel Duct Fabricated in Job #15

EQUIPMENT: Cornice Brake
Bar Folder

TOOLS: Rule, Scribe, Marking Gage, Handy Seamer

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Use handy seamer (tongs) to bend the ½" edge already marked along the 8" sides of duct produced in Job #15, so that edge is bent 180^0 but is open enough to allow drive clips. 	
2. Fabricate two "S" slips and two drive clips from 22 gage galvanized steel.	
3. Install slips on duct and join someone else's duct to yours.	
4. Install drive clips to hold joints of pipe together.	

METHOD OF EVALUATION:

1. Check for neatness and appearance of drive cleat after it is bent.
2. Check for tightness of seam when ducts are joined.

JOB: Fabricate Cylindrical Pail

UNIT II: Fabrication

COURSE: Metal Fabrication

MATERIAL: 26 Gage Galvanized Steel

EQUIPMENT: Notcher
Wiring Rolls
Ring and Circle Shear

TOOLS: Rule
Scribe
Straight Snips

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-2-23

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Using pattern for cylindrical pail place paper pattern on metal and hold it down with weights.	
2. Scribe around the pattern to mark the metal and prick punch the bend lines.	. SC-1-5A, SC-2-1
3. Cut out pattern with straight snips.	. SC-2-2
4. Notch corners.	. SC-2-2B
5. Cut out bottom on ring and circle shear.	. SC-2-22
6. Turn side seam on bar folder.	. SC-2-10
7. Groove and set side seam with hand groover.	. SC-2-6
8. Double seam the bottom in the pail.	
9. Put a wired edge in the top.	. SC-2-41
10. Fabricate and attach bail.	
11. Flame solder bottom water tight.	

METHOD OF EVALUATION:

1. Check overall accuracy and appearance.
2. Check for water tightness.

JOB: Fabricate a Funnel

UNIT II: Fabrication

COURSE: Metal Fabrication

MATERIAL: 26 Gage Galvanized Steel
Pattern Drawn in Pattern Drafting Unit

EQUIPMENT: Notcher
Foot Shear
Ring and Circle Shear

TOOLS:
Rule
Scribe
Hammer
Stakes
File
Prick Punch
Wiring Rolls
Handy Seamer
Straight Snips
Hand Groover
Aviation Snips

JOB SHEET
IDENTIFICATION CODE

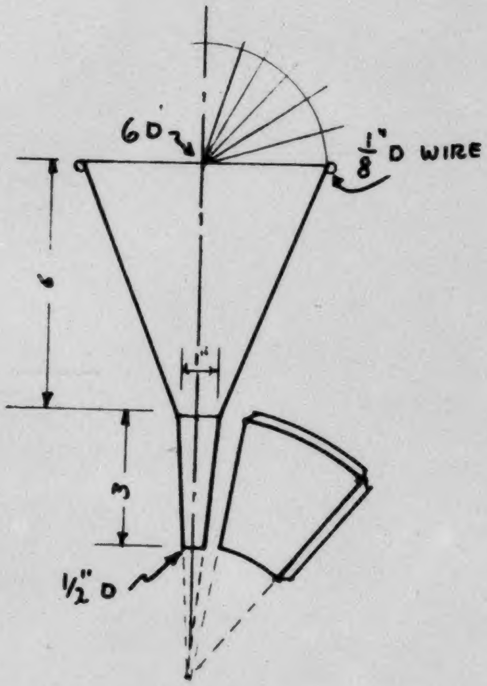
JOB NUMBER: J-2-24

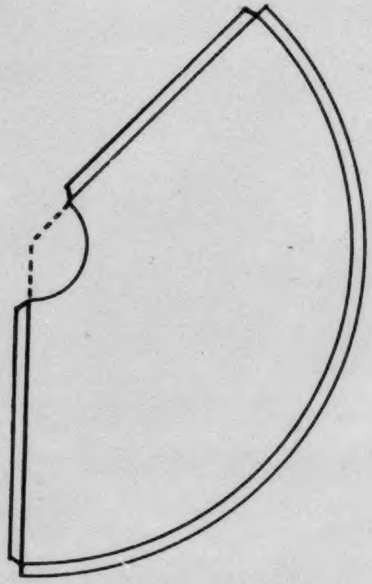
DRAWING NO: D-2-24

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Place pattern on metal. Place weights to hold the pattern. Scribe around pattern. Prick punch bend lines.	. SC-1-5A, SC-2-1
2. Cut out funnel body and spout.	. SC-2-22, SC-2-2, SC-2-3
3. Notch seams at corners.	. SC-2-2B, SC-2-2C
4. Bend single lock side seam.	. SC-2-29
5. File and smooth the edge of any burrs.	. SC-2-35
6. Form funnel on forming stakes.	. SC-2-42
7. Complete the side seam.	. SC-2-6
8. Wire the top edge.	. SC-2-41
9. Attach spout and make it water tight.	. SC-2-31

METHOD OF EVALUATION:

1. Check job for overall accuracy and appearance.
2. Check for alignment of the top and bottom tapers.


60°
1/8" D WIRE
6
1"
3
1/2" D



FUNNEL

DRAWING NUMBER
D-2-24

JOB: Angle Iron Shelf Bracket

UNIT II: Fabrication

COURSE: Metal Fabrication

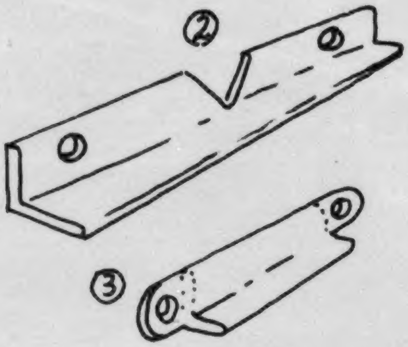
MATERIAL: 1 X 1 X 1/8" Angle Iron
4 lb. Rivets

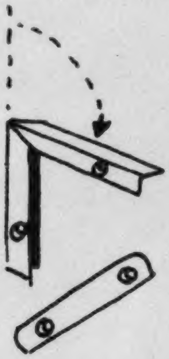
TOOLS: Rule Hack Saw
Scribe Hand Drill

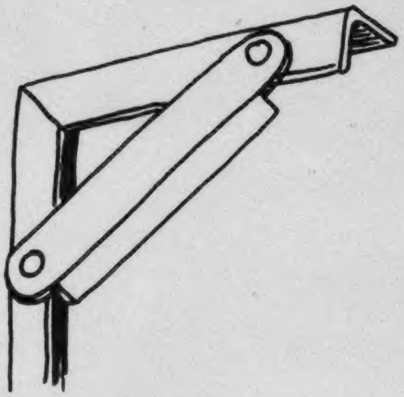
JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-2-25

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Cut angle iron to length.	. SC-1-5A, SC-2-1,
2. Cut out a 90° notch where the bracket bends.	. SC-2-25
3. Cut angle brace and notch the ends.	. SC-2-25
4. File and round all ends and corners.	. SC-2-35
5. Drill rivet holes through brace and bracket.	. SC-2-33
6. Drive rivets in holes.	. SC-2-4







METHOD OF EVALUATION:

Check the job for overall accuracy and appearance.

JOB: Metal Liner

UNIT II: Fabrication

COURSE: Metal Fabrication

JOB SHEET
IDENTIFICATION CODE

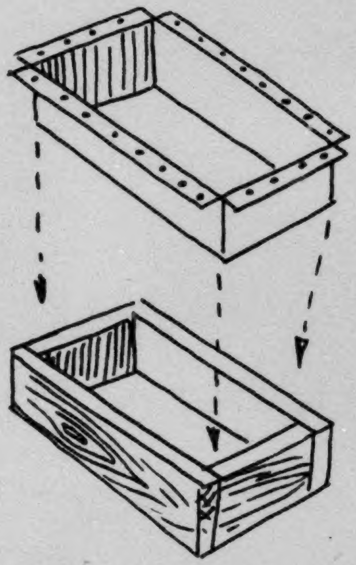
JOB NUMBER: J-2-26

MATERIAL: 26 Gage Galvanized Steel
Pattern from Unit on Pattern Drafting
(20) #8 X 3/4 Roundhead Slotted Woodscrews

EQUIPMENT: Cornice Brake
Foot Shear
Notcher

TOOLS: Rule
Scribe
Screwdriver
Straight Snips
Marking Gage
Hand Punch
Hand Drill

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Place paper pattern on metal. Hold it down with weights. Mark outline with scribe and rule and prick punch bend lines.	. SC-1-5A, SC-2-1
2. Cut outline with squaring shear.	. SC-2-20
3. Notch out corners.	. SC-2-2B
4. Cut out corner tabs.	. SC-2-22
5. File all edges smooth.	. SC-2-35
6. Mark screw hole centers with marking gage.	. SC-2-1A
7. Prick punch and punch holes with hand punch.	. SC-2-37
8. Bend up box with cornice brake.	. SC-2-11
9. Solder corners of liner water tight.	. SC-2-31
10. Insert metal liner in wooden box and secure with wood screws.	. SC-2-9



METHOD OF EVALUATION:

Check the fit of liner in wooden box.

JOB: Fabricate Angle Iron

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-2-27

UNIT II: Fabrication

COURSE: Metal Fabrication

MATERIAL: 16 Gage Galvanized Steel

EQUIPMENT: Power Shear
Press Brake
Pedestal Grinder

TOOLS: Rule
Scribe

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Lay out a strip 2" wide and 4' long on 16 gage galvanized steel with a bend line one inch in at each end.	. SC-1-1, SC-2-2
2. Cut out project on power shear.	. SC-2-26
3. Bend a 90° angle through bend lines on press brake.	. SC-2-42
4. Smooth all edges on pedestal grinder.	. SC-2-43

METHOD OF EVALUATION:

1. Check for smoothness of all edges.
2. Check for overall accuracy of the job.

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-2-28

JOB: Fabricate a Drain Cover

UNIT II: Fabrication

COURSE: Metal Fabrication

MATERIAL: 20 Gage Galvanized Steel

EQUIPMENT: Ring and Circle Shear
Drill Press

TOOLS: Rule
Scribe
File
Prick Punch
Drill Bit

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Set ring and circle shear and cut an 8" diameter circle of 20 gage galvanized steel.	. SC-2-35
2. With scribe and rule mark out the surface of the 8" circle into 3/4" squares.	. SC-1-1, SC-2-2
3. Prick punch at intersection of each scribe line.	. SC-2-4
4. Use drill press to drill all prick punches.	. SC-2-44
5. File edges smooth.	. SC-2-38
6. Remove burrs from holes.	. SC-2-45

METHOD OF EVALUATION:

Check job for overall accuracy and appearance.

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-2-29

JOB: Vent Pipe (Through Wall)

UNIT II: Fabrication

COURSE: Metal Fabrication

MATERIAL: 2" Pipe
Solder
Copper Screen Wire
Soldering Flux

EQUIPMENT: Band Saw
Depressed Center Wheel on Portable Grinder

TOOLS: Rule
Soldering Irons
Straight Snips

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Cut end of pipe on band saw at 45° angle.	. SC-2-46
2. Dress cut end with portable grinder using a depressed center wheel.	. SC-2-47
3. Cut copper wire to fit angled end of pipe.	. SC-2-5
4. Solder screen wire over angled end of pipe.	. SC-2-36

METHOD OF EVALUATION:

1. Check edges for smoothness.
2. Check fit of screen.

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-2-30

JOB: Make Washers

UNIT II: Fabrication

COURSE: Metal Fabrication

MATERIAL: 16 Gage Galvanized Steel

EQUIPMENT: Turret Punch

TOOLS: Burring Tools

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Punch out 1/4" center hole and 7/8" outside diameter using 16 gage galvanized steel on turret punch.	. SC-2-48
2. Remove any burrs.	. SC-2-45

METHOD OF EVALUATION:

1. Check overall size.
2. Check for removal of all burrs.

JOB: Aluminum Minibox

UNIT II: Fabrication

COURSE: Metal Fabrication

MATERIAL: .050 Aluminum

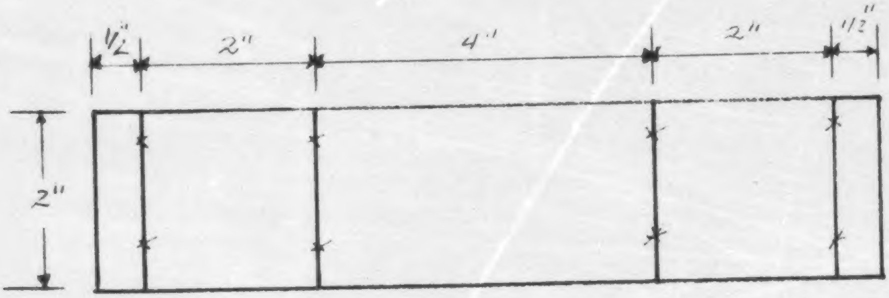
EQUIPMENT: Foot Shear
Cornice Brake
Disc Sander

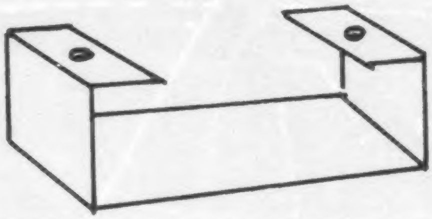
TOOLS: Rule, Scribe, Prick Punch, Hand Punch

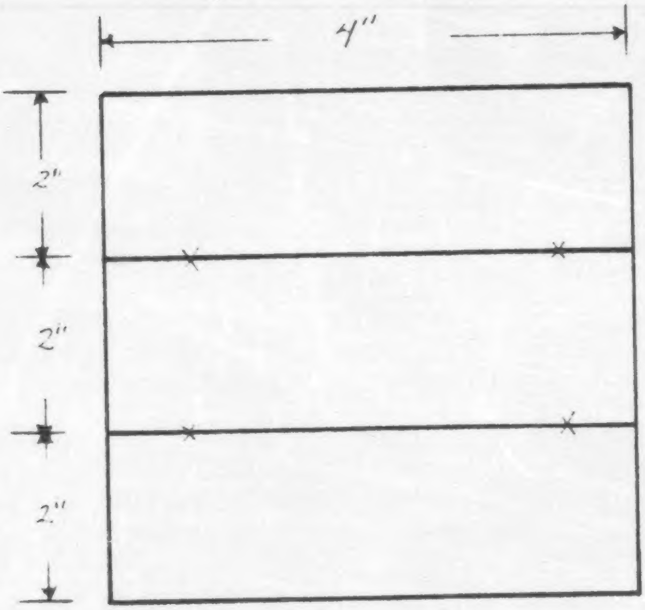
JOB SHEET IDENTIFICATION CODE

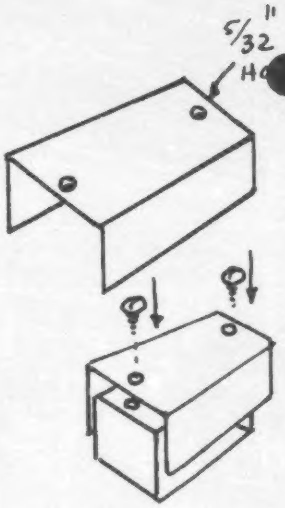
JOB NUMBER: J-2-31

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Lay out one piece.	. SC-1-1, SC-2-2
2. Prick punch bend lines.	. SC-2-4
3. Cut out on squaring shear.	. SC-2-14
4. Bend 90° up on each bend line.	. SC-2-3
5. Lay out cover.	. SC-1-1, SC-2-2
6. Prick punch bend lines.	. SC-2-4
7. Cut out on foot squaring shear.	. SC-2-14
8. Bend up 90° on each bend line with the cornice brake.	. SC-2-3
9. File all edges smooth.	. SC-2-35
10. Punch a hole on center face of cover ¼" from each end.	. SC-2-23
11. Place cover over box and drill 1/8" hole through 1/2" flange of lower piece with electric hand drill.	. SC-2-40
12. Remove burrs from all holes.	. SC-2-45
13. Sand any irregular corners.	. SC-2-49
14. Screw cover onto box with two ½" X #7 pan head sheet metal screws.	. SC-2-41









METHOD OF EVALUATION:

1. Check the fit of the cover.
2. Be sure all burrs were removed.
3. Check for tightness of metal screws.

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-2-32

JOB: Cut a 10" Diameter Circle

UNIT II: Fabrication

COURSE: Metal Fabrication

MATERIAL: 20 Gage Galvanized Steel

EQUIPMENT: Unishears

TOOLS: Dividers, Rule, Scribe, Burring Tool

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Scribe a 10" diameter circle on 20 gage galvanized steel with dividers.	. SC-1-1, SC-2-2
2. Use unishear to cut out circle.	. SC-2-50
3. Use burring tool to remove burrs.	. SC-2-45

METHOD OF EVALUATION:

Check overall size and neatness of job.

JOB SHEET IDENTIFICATION CODE

JOB: Cut an 8" Square Plate - Coordinate Nibbling

UNIT II: Fabrication

JOB NUMBER: J-2-33

COURSE: Metal Fabrication

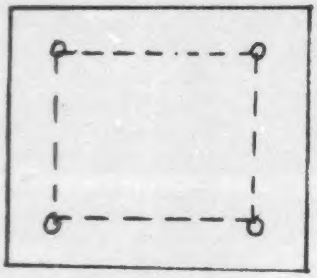
MATERIAL: 1 piece, Cold Rolled Steel - 12" X 12" X 1/8"

EQUIPMENT:
Nibbler
Lower Die Head
Hollow Punch
Guide Pin and Die

TOOLS:
Open End Wrenches
Allen Wrenches

SAFETY PRECAUTIONS:

Wear your safety glasses.
Watch your fingers.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Properly install hollow punch guide pin and lower die in the machine.	NOTE: Be sure you have the clearance and stroke length correct.
2. Adjust the machine speed to copy nibbling (500 RPM).	. SC-2-51
3. Scribe an 8" square in the center of the plate.	
4. Place plate in clamps on cross feed bar.	
5. Manually lower the punch and adjust the feed bar until the punch touches the outside of the line.	
6. Start the machine. Turn the die down till it punches thorugh the metal.	
7. Raise the guide pin up into the hollow die.	
8. With steady pressure, feed the metal into the punch until the cut is complete.	

COMPETENCE - PROCEDURE/STEPS | TEACHING/LEARNING ACTIVITIES

9. Lock the longitudinal bar.

10. Locate punch edge on the line running from front to rear of the machine.

11. Release the transverse bar lock and make the cut.

12. Proceed with the remaining 2 cuts until the square is completely cut out.

13. File and clean all burrs.

METHOD OF EVALUATION:

1. Check for correct set up of metal worker before job is started.
2. Check accuracy of cut.

JOB: Slot a Hole in a Plate

UNIT II: Fabrication

COURSE: Metal Fabrication

MATERIAL: 1 piece, 1/8" Aluminum: 14" X 14"

EQUIPMENT: Metal Worker

TOOLS: Wrenches
Rule
Scribe

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-2-34

SAFETY PRECAUTIONS:

Wear safety glasses.
Keep long sleeves tight or rolled up.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Install slotting tools.	. SC-2-52
2. Adjust stroke length and speed.	
3. Place metal in longitudinal guide bar clamps and secure.	
4. Adjust stops to length and width of hole you wish to slot, lock stops tightly.	
5. Turn punch adjusting handle until slotting tool penetrates the metal (2 mm.)	
6. Make longitudinal slots until preset stops stop cutting.	
7. Lock longitudinal guide bar.	
8. Release transverse guide bar lock.	
9. Make transverse slot cuts until hole is complete.	NOTE: There should be very little metal distortion.

METHOD OF EVALUATION:

Check hole for accuracy of size and cleanliness.

JOB: Cut or Shear Strips with Metal Worker

JOB SHEET IDENTIFICATION CODE

UNIT II: Fabrication

JOB NUMBER: J-2-35

COURSE: Metal Fabrication

MATERIAL: 1/8" Plate, 24" X 12"

EQUIPMENT: Nibbler

TOOLS:
Rule
Wrenches

SAFETY PRECAUTIONS:

Wear glasses.
Be careful of fingers.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Install top and bottom cutter in punch and lower die.	. SC-2-53
2. Adjust stroke length according to metal thickness.	
3. Adjust air gap (15% of metal thickness).	
4. Set dial to cutting speed.	
5. Place metal in longitudinal guide bar and clamp securely.	
6. Set bar guide reading at 2".	
7. Lock transverse bar.	
8. Feed metal through cutters until cut is complete.	
9. Set guide bar reading at 4".	
10. Make complete cut.	
11. Proceed in this manner until you have cut a total of 10 strips.	

METHOD OF EVALUATION:

Check accuracy of cut and overall size and appearance of strips.

JOB: Flange a 10" Diameter Disc

UNIT II: Fabrication

COURSE: Metal Fabrication

MATERIAL: 10" - 20 Gage Galvanized Steel Disc
(Fabricated in J-2-32)

EQUIPMENT: Nibbler

TOOLS: Rule
Wrenches

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-2-36

SAFETY PRECAUTIONS:

Do not put fingers near working parts of flanging tools.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Install small flanger into proper tool heads.	. SC-2-54
2. Adjust flangers to thickness of metal plus .004".	
3. Set stroke length at 3 MM.(.12").	
4. Set stroke speed between 1100 and 14-0.	
5. Place disc center exactly on center of inside circle attachment.	
6. Start the machine.	
7. Slowly rotate disc until flange has been completed.	
8. Pass it through one more time to make sure flange is finished at all points.	

METHOD OF EVALUATION:

Check flange for size and appearance, there should be no kinks or buckles in the flanged edge.

JOB: Ventilator Cap

UNIT II: Fabrication

COURSE: Metal Fabrication

JOB SHEET
IDENTIFICATION CODE

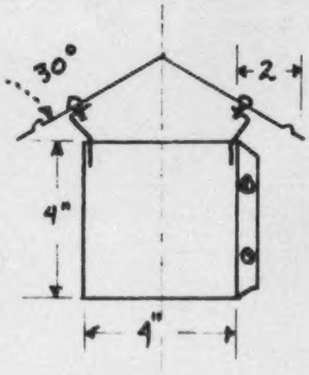
JOB NUMBER: J-2-37

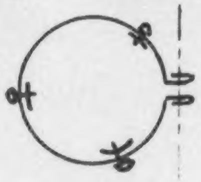
MATERIAL: (2) Bolts 3/16 X 1 with Nuts
(6) Two Pound Rivets
26 Gage Galvanized Steel

EQUIPMENT: Cornice Brake
Foot Shear
Round Turning Roll

TOOLS:
Rule
Scribe
Hammer
Stakes
Prick Punch
Hand Punch
Dividers
Straight Shears
Rivet Set

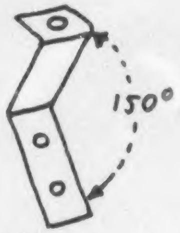
COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Lay out cone-shaped cover (26 gage), three 20 gage legs and a 26 gage drawband.	. SC-1-1, SC-2-2
2. Prick punch holes and bend lines.	. SC-2-4
3. Cut out straight cuts on foot squaring shear.	. SC-2-14
4. Cut cover out with straight snips.	. SC-2-5
5. Punch rivet holes (5/32) with hand punch.	. SC-2-23
6. Form cover on bench stakes.	. SC-2-37
7. Rivet seam on cover and rivet legs to cover.	. SC-2-24
8. Form draw band on slip roll former and brake.	. SC-2-16, SC-2-3
9. Rivet legs to draw band.	. SC-2-24
10. Punch 7/32" holes in draw band for bolts.	. SC-2-23
11. Install bolts.	





METHOD OF EVALUATION:

1. Check overall accuracy and appearance of job.
2. Check alignment and spacing of legs.



JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-2-38

JOB: Air Scoop

UNIT II: Fabrication

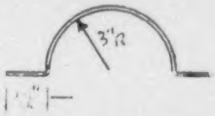
COURSE: Metal Fabrication

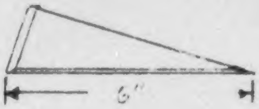
MATERIAL: 26 Gage Galvanized Steel

EQUIPMENT: Cornice Brake, Turning Machine, Foot Squaring Shear, Slip Roll Former, Hand Punch

TOOLS: Rule, Scribe, Straight Snips, Prick Punch, Dividers, Hammer, Stakes

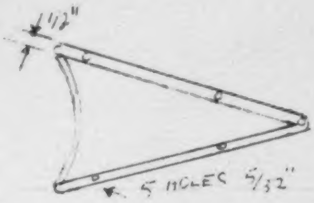
COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Lay out elevation view of air scoop.	
2. Draw pattern on 26 gage galvanized steel using rule, scribe and dividers.	. SC-1-1, SC-2-2
3. Cut straight lines with foot shear.	. SC-2-14
4. Cut curved cuts with straight snips.	. SC-2-5
5. Prick punch hole centers.	. SC-2-4
6. Punch holes with hand punch.	. SC-2-23
7. Start to shape scoop on slip roll former.	. SC-2-16
8. Finish shaping scoop on stakes.	. SC-2-37
9. Bend 1/2" edges on cornice brake.	. SC-2-3
10. Finish leading edge of scoop by turning with thick turning roll.	. SC-2-20





METHOD OF EVALUATION:

Check for roundness of scoop especially at the flanges.



JOB: Tapered Bucket

JOB SHEET
IDENTIFICATION CODE

UNIT II: Fabrication

JOB NUMBER: J-2-39

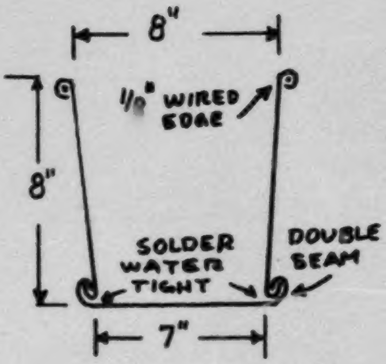
COURSE: Metal Fabrication

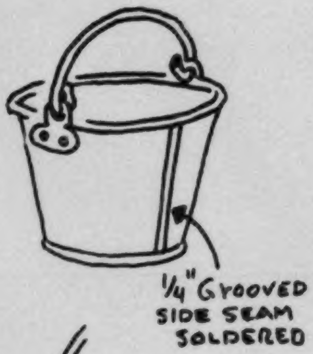
MATERIAL:
26 Gage Galvanized Steel
1/8" Steel Gas Welding Wire
3/16" Rod for Bail
16 Gage Steel for Lugs
(4) 3 Pound Rivets

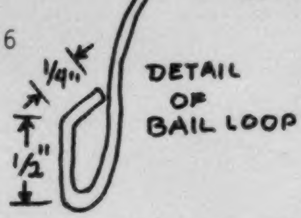
EQUIPMENT:
Slip Roll Former
Bar Folder
Turning Machine
Ring and Circle Shear
Notcher

TOOLS:
Rule
Scribe
Prick Punch
Straight Snips
Hammer
Groover

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Lay out tapered bucket using radial line development. Be sure to leave seam allowances.	SC-1-1, SC-2-2
2. Cut out pattern using straight snips.	SC-2-5
3. Notch corners at seams.	SC-2-6
4. Fold side seam on bar folder.	SC-2-7
5. Roll bucket on slip roll former.	SC-2-16
6. Groove and set side seam.	SC-2-8
7. Prepare pocket for wired edge.	SC-2-20
8. Roll wire to fit bucket.	SC-2-16
9. Finish wired edge.	SC-2-21
10. Burr bottom of bucket on burring machine.	SC-2-
11. Prepare a 26 gage disc for bottom on ring and circle shear.	SC-2-35
12. Finish double seamed bottom.	SC-2-6
13. Prepare lugs for bail in 16 gage cut with notcher and punch hole 3/8".	SC-2-23
14. Prepare bail in slip roll former and vise.	SC-2-16







COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
15. Place lugs on bail before riveting bail to bucket.	. SC-2-40, SC-2-24
16. Solder bucket watertight.	. SC-2-36

METHOD OF EVALUATION:

1. Check overall appearance and accuracy of bucket.
2. Check bail loop size.

JOB: Tool Chest

UNIT II: Fabrication

COURSE: Metal Fabrication

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-2-40

DRAWING NO: D-2-40 pgs 1 & 2

MATERIAL:
18 Gage Black Iron Cold Rolled
1/4" Round Rod
Hasp Assembly
Piano Hinge
Rivets

EQUIPMENT:
Press Brake
Cornice Brake
Power Shears
Box and Pan Brake
Electric Drill
Bench Stakes

TOOLS:
Scale Rule
Scribe
Square
Hand Punch
Rivet Set
Riveting Hammer
Files

SAFETY PRECAUTIONS:

1. Machine Safety.
2. Material Handling Safety.
3. Personal and fellow worker safety precautions.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Measure and cut blank 21-1/2" X 16".	
2. Mark and notch blank as shown on print.	
3. Measure and punch 1/8" holes (take hole locations from print).	
4. Form this piece into the tool box body.	
5. Layout the two body ends.	
6. Cut and form two angles (90°) 1" X 1" X 7-3/4" long.	
7. Position on end pieces, drill and rivet.	
8. Position 2 end pieces in box body,drill and rivet.	
9. Layout, cut and form the two lid pieces. (Details on print.)	
10. Drill and rivet piano hinges to these lids.	
11. Locate hinged lids to box, drill and rivet.	

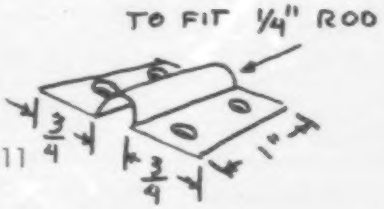
COMPETENCE - PROCEDURE/STEPS | TEACHING/LEARNING ACTIVITIES

12. Layout inner tray 1/4" smaller in length and width than inside chest measurements.

13. Form, drill and rivet tray as shown on print.

14. Fabricate and install tray handle.

15. Cut and form 1/4" diameter rods into handles.



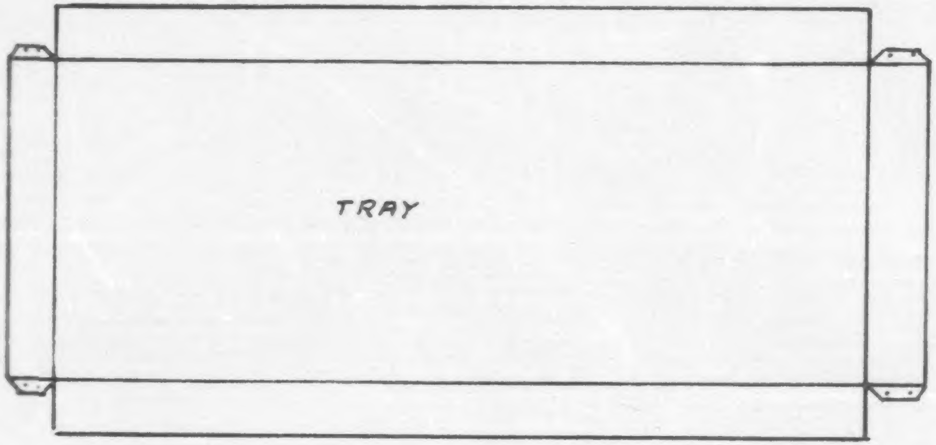
16. Fabricate 4-18 9A Black Cleats.

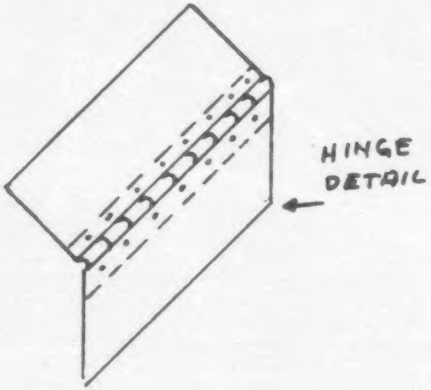
17. Position these cleats over handles, drill and rivet as shown on print.

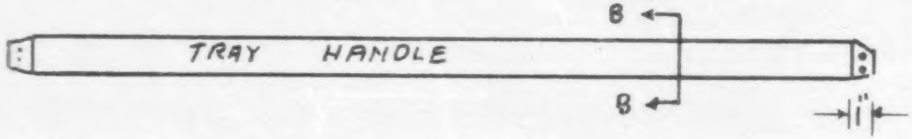
18. Locate hasp assembly and rivet to lids.

METHOD OF EVALUATION:

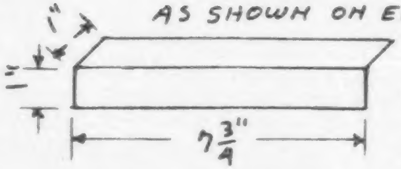
1. Check overall accuracy and appearance of tool box.
2. Check for lid fit and hinge alignment.

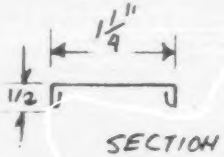



HINGE DETAIL


B
B
TRAY HANDLE
1"

MAKE 2 ~ INSTALL AS SHOWN ON END VIEW

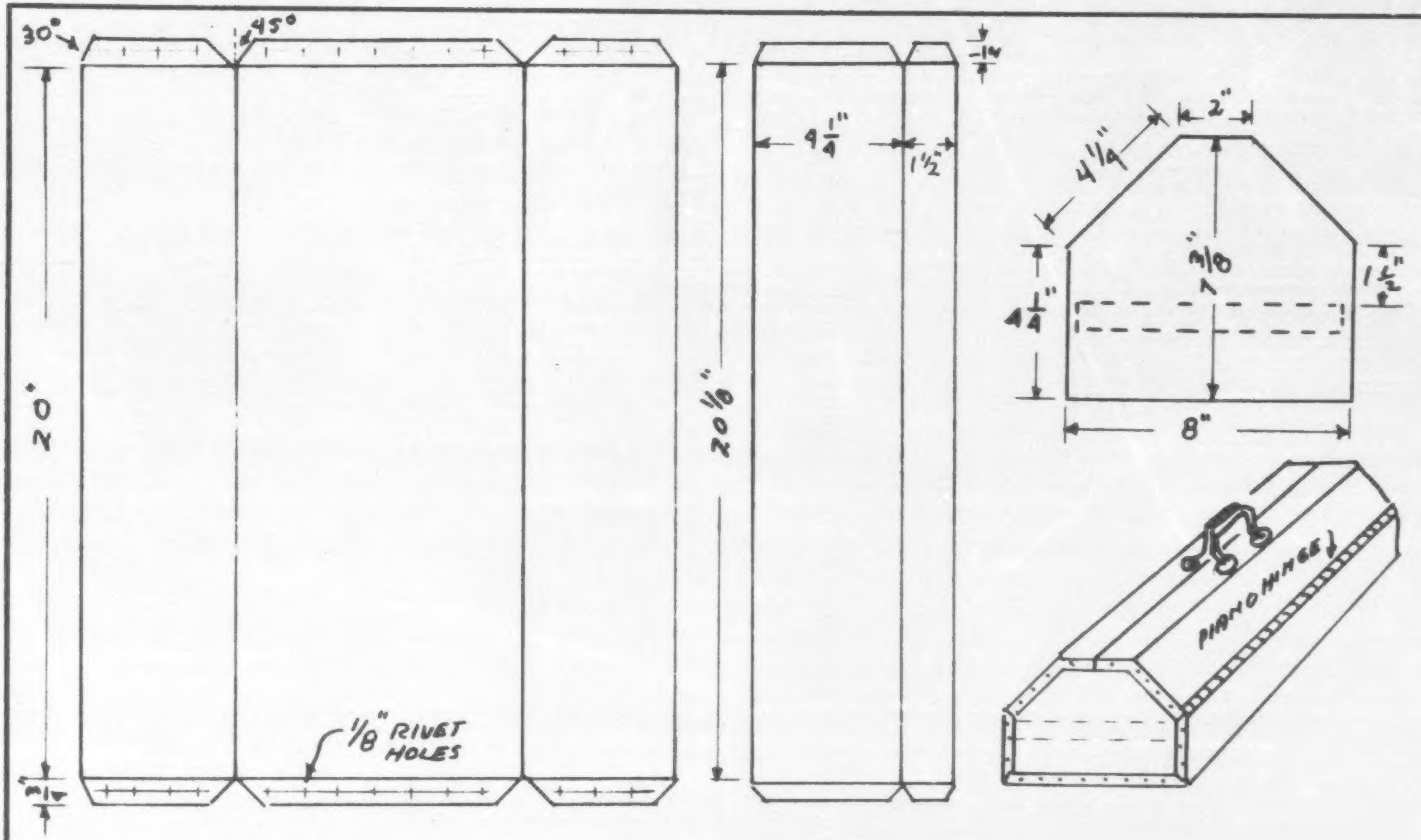




SECTION B-B

TOOL CHEST

DRAWING NUMBER
D-2-40 pg. 1



30°
45°
20"
3/4
1/8" RIVET HOLES
20 1/8"
4 1/4"
1 1/2"
1/4
4 1/4"
2"
3/8"
1 1/2"
4 1/4"
8"
PIANO HINGE

TOOL CHEST

DRAWING NUMBER

D-2-40 pg. 2

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-2-41

DRAWING NO: D-2-41 pgs 1 & 2

JOB: Make an Ash Tray Stand

UNIT II: Fabrication

COURSE: Metal Fabrication

MATERIAL: 16 Gage Cold Rolled Steel
3/16" Cold Rolled Rod
Primer and Enamel Paint

EQUIPMENT: Nibbler
Pedestal Grinder
Food Shears
Drill Press
Welding (Oxy-Acetylene) Unit

TOOLS: Rule
Scribe
Hammer
File
Drill Bits
Emery Paper
Hack Saw

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Scribe and cut two 7" circles of 16 gage black iron.	
2. Scribe and cut two 10" diameter circles of 16 gage black iron.	
3. Mark and shear 1 piece 2" X 22".	
4. Mark and shear 1 piece 2" X 31 1/2".	
5. File and grind all edges smooth.	
6. Cut a 6" diameter hole in the center of one of the 7" flats.	
7. Roll the 22" and 31 1/2" pieces into perfect round rings.	
8. Weld and clean as shown on print.	
9. Lay out and drill holes to specified size.	
10. Cut 18 pieces 3/16" rod, 24" long.	

11. Bevel the ends on the grinder.

12. Insert the rods into the holes in the bottom and top pans.

13. Twist rods until they all come together in the center of 24" height.

14. Prime and paint.

15. Place glass ash tray in hole on top of the stand.

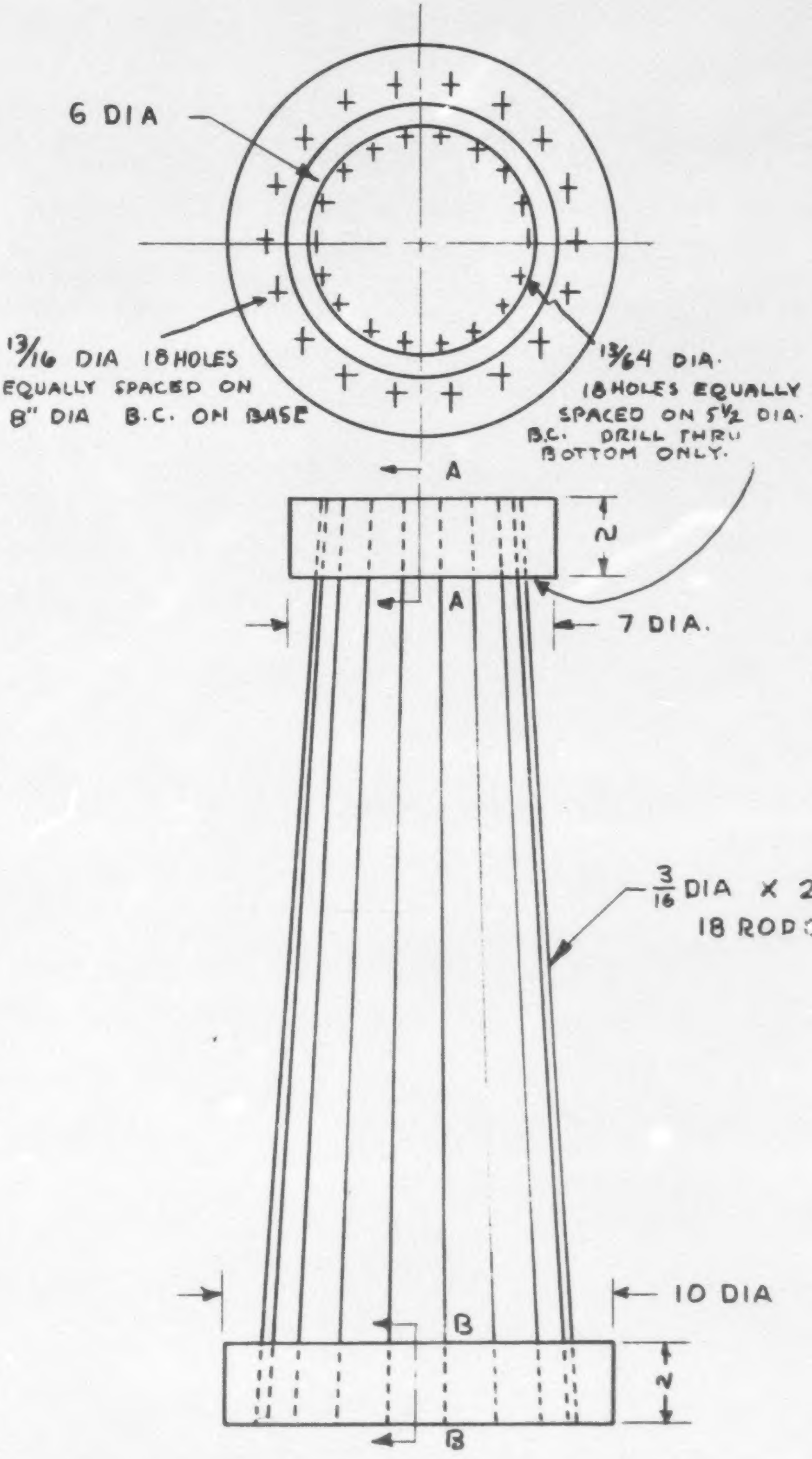
METHOD OF EVALUATION:

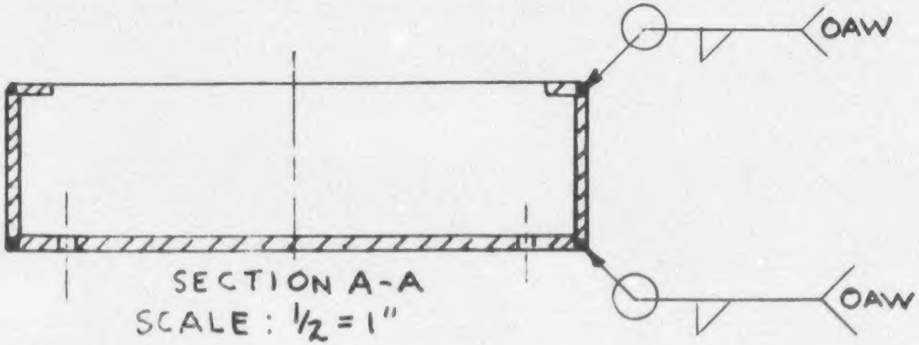
1. Stand should set straight and show no welds.
2. The paint must be smooth and even with no run marks.

ASH TRAY STAND

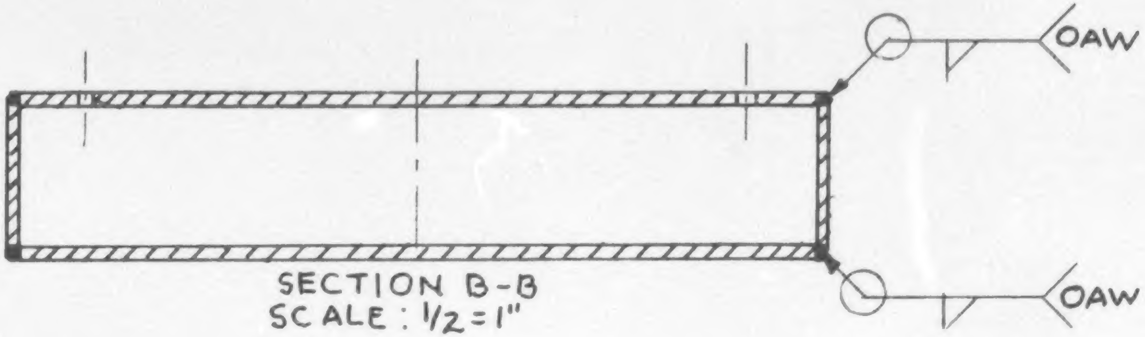
DRAWING NUMBER

D-2-41 pg. 1


6 DIA
13/16 DIA 18 HOLES EQUALLY SPACED ON 8" DIA B.C. ON BASE
13/64 DIA. 18 HOLES EQUALLY SPACED ON 5½ DIA. B.C. DRILL THRU BOTTOM ONLY.
A
A
2
7 DIA.
3/16 DIA X 24 LG. 18 RODS
10 DIA
B
B
2



SECTION A-A
SCALE: 1/2 = 1"



SECTION B-B
SCALE: 1/2 = 1"

ASH TRAY STAND

DRAWING NUMBER

D-2-41 pg. 2

JOB: Make a Magazine Rack

UNIT II: Fabrication

COURSE: Metal Fabrication

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-2-42

DRAWING NO: D-2-42 pgs 1 & 2

MATERIAL:
18 Gage Black Iron
1/2" Conduit Pipe
Oak or Maple Base
Screws
1/2" Wood Dowel

EQUIPMENT:
Drawing Equipment
Oxy-Welding Unit
Sabre Saw
Power Shears
Press or Cornice Brake

TOOLS:
Drawing Tools
Prick Punch
File
Screwdriver
Hand Drill
Rule
Scribe
Emory Paper

SAFETY PRECAUTIONS:

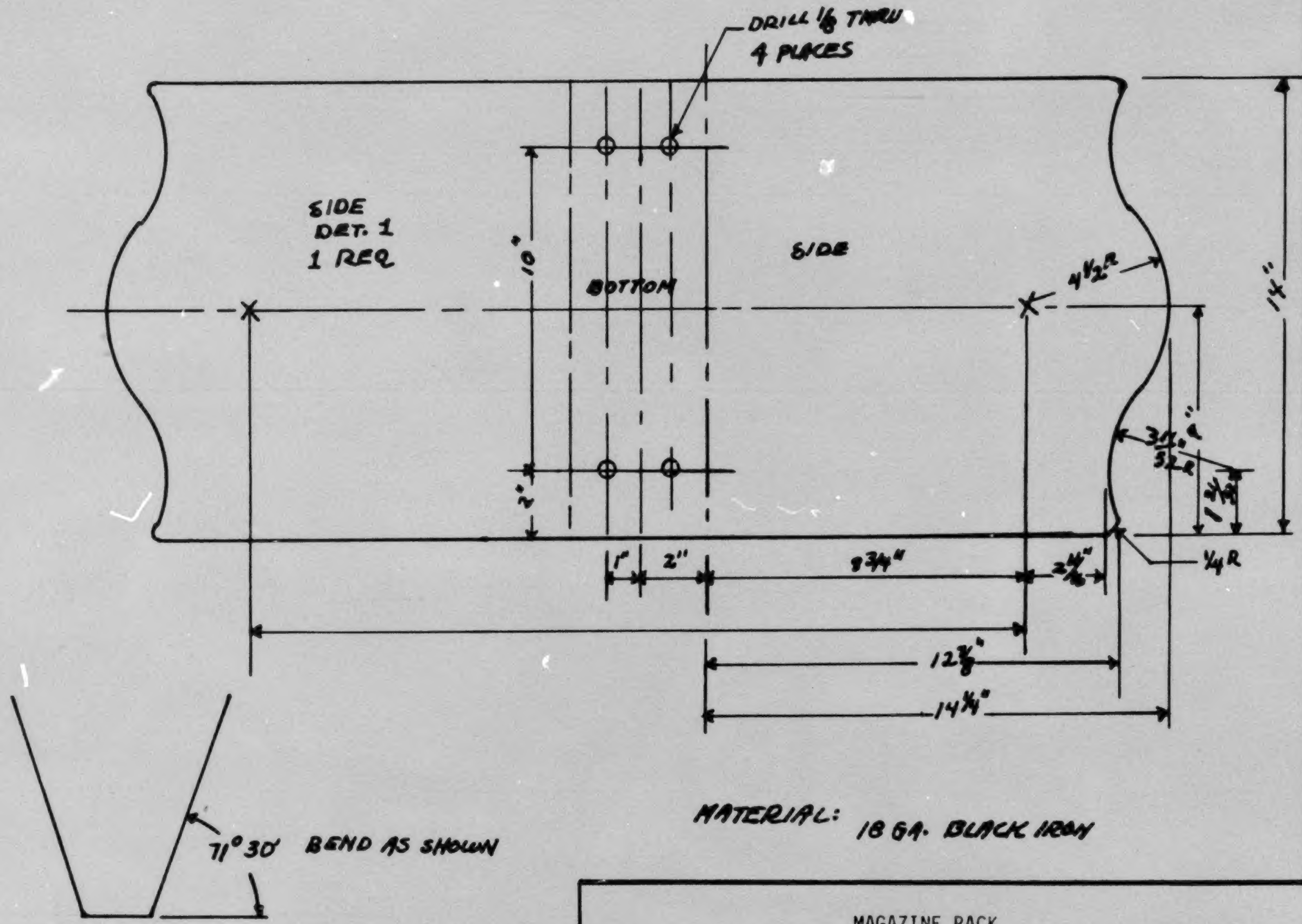
1. Wear necessary protective equipment.
2. Keep a careful eye out for fellow workers.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Lay out paper patterns to full size for the body and two ends.	
2. Transfer paper patterns to metal.	
3. Scribe all cut marks, and prick punch all bend marks.	
4. Center punch hole locations and drill holes to size on print.	
5. File and sand all edges smooth.	
6. Have carpentry shop cut and form the wood base.	
7. Bend the body to proper degree.	
8. Place the sides in position and tack weld each joint at four places.	
9. Cut 1/2" conduit pipe and insert 1/2" dowel through the entire length.	

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
10. Fasten the conduit handle to the body as shown on print.	
11. Screw the metal body to the wood base.	
12. Sand, smooth and prepare for painting.	

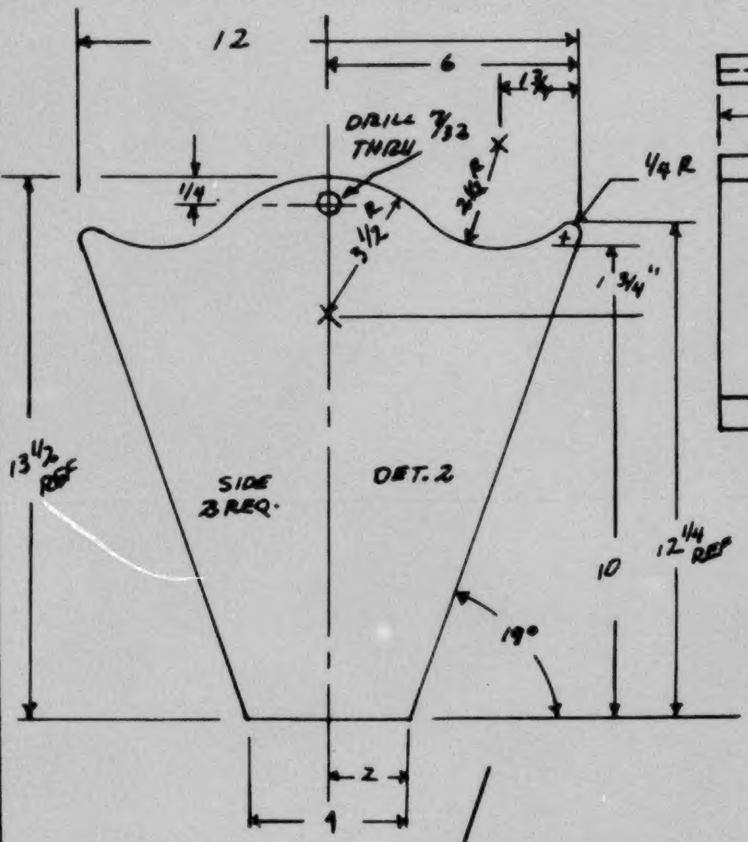
METHOD OF EVALUATION:

If you could sell this project and the customer would be well satisfied, you have done a good job.

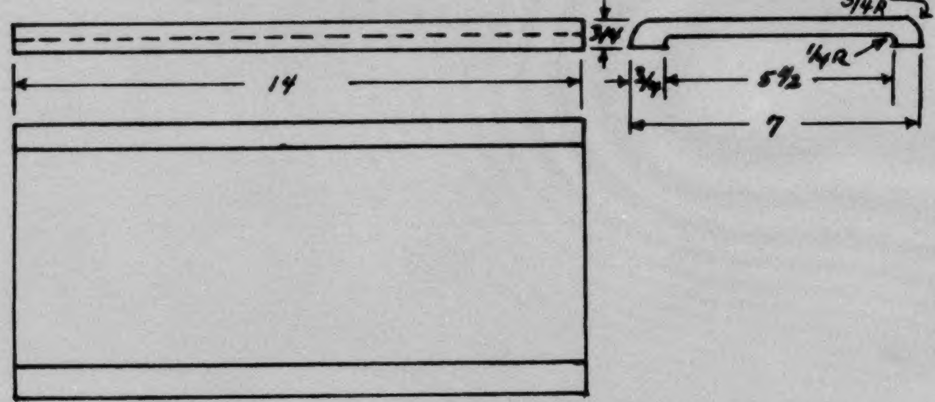

DRILL 1/8 THRU
4 PLACES
SIDE
DET. 1
1 REQ
BOTTOM
SIDE
10"
2"
14"
4 1/2" R
4"
3 1/32" R
1 3/16"
1/4 R
1"
2"
8 3/4"
2 1/16"
12 7/8"
14 1/4"
71° 30' BEND AS SHOWN
MATERIAL: 18 GA. BLACK IRON

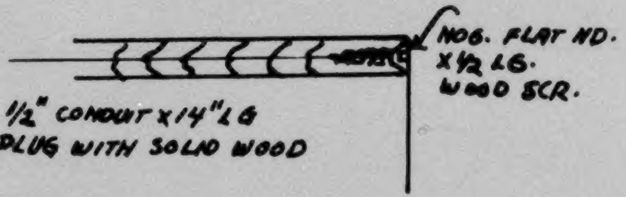
MAGAZINE RACK

DRAWING NUMBER
D-2-42 pg. 1


12
6
1 3/4
1/4
2 1/2 R
1/4 R
3 1/2
1 3/4"
13 1/2 REF
SIDE
2 REQ.
DET. 2
10
12 1/4 REF
19°
2
4

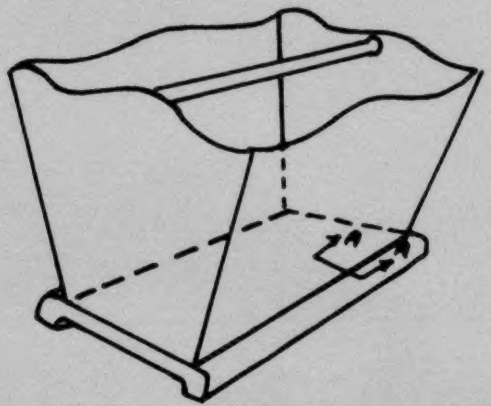
DRILL 7/32 THRU

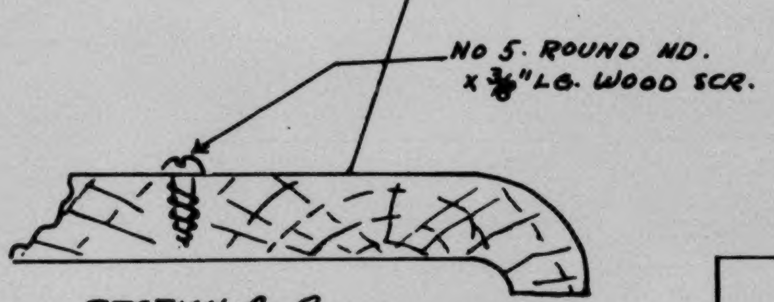

3/4
14
3/4 R
1/4 R
3/4
5 1/2
7



NO 6. FLAT HD. X 1/2 LG. WOOD SCR.

1/2" CONDUIT X 14" LG
PLUG WITH SOLID WOOD





NO 5. ROUND HD. X 3/8" LG. WOOD SCR.

SECTION A-A-

MAGAZINE RACK

DRAWING NUMBER

D-2-42 pg. 2

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-2-43

JOB: Make a Rectangular Hopper

UNIT II: Fabrication

COURSE: Metal Fabrication

MATERIAL:
24 Gage Black Iron
Rivets
Paper

EQUIPMENT:
Drawing Equipment
Shears
Cornice Brake
Stakes

TOOLS:
Scale
Rule
Pencil
Steel Square
Compass
Scratch Awl
Prick Punch
Dividers
Snips
Mallet
Weights
Hand Punch
Rivet Set
Hammer

SAFETY PRECAUTION:

Observe all shop safety precautions, particularly on the use of the power shears.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Lay out plan and elevation according to drawing.	
2. Develop the pattern for the taper piece.	
3. Develop the pattern for the bottom and top pieces as per print specifications.	
4. Lay out all rivet holes, notches and brake lines.	
5. Cut out and notch paper patterns.	
6. Select stock and place patterns on stock.	
7. Transfer all patterns to the metal.	
8. Cut out and notch metal.	
9. Punch rivet holes.	
10. Bend tapered piece in cornice brake.	

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
11. Rivet the seam.	
12. Cut out and notch top and bottom patterns.	
13. Punch rivet holes.	
14. Form all hems, flanges and body bends in the hand brake.	
15. Rivet seams together on top and bottom piece.	
16. Rivet the collars to the tapered piece.	
17. Check completed job for accuracy.	

METHOD OF EVALUATION:

You will fit this job into a specified opening if it is correct. The top will fit the top opening and the bottom piece will fit into its specified opening.

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-2-44

JOB: Pitched Cover

UNIT II: Fabrication

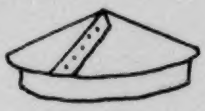
COURSE: Metal Fabrication

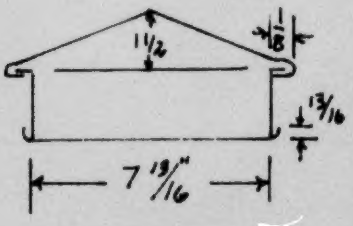
MATERIAL: 26 Gage Galvanized Steel
1-1/2 Pound Rivets

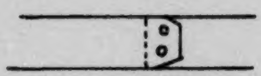
EQUIPMENT: Burring Machine
Foot Squaring Shear

TOOLS: Rule
Scribe
Hammer
Prick Punch
Hand Punch
Dividers
Straight Shears

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Lay out cover using radial line development procedure.	. SC-1-1, SC-2-2
2. Cut out sloping piece with straight shears.	. SC-2-5
3. Cut band on foot shear.	. SC-2-14
4. Notch corners at seams on notcher.	. SC-2-6
5. Fold edges of band on cornice brake.	. SC-2-3
6. Prick punch rivet holes.	. SC-2-4
7. Punch rivet holes with hand punch.	. SC-2-23
8. Roll band on slip roll former.	. SC-2-16
9. Form sloping piece on stakes.	. SC-2-37
10. Rivet both pieces.	. SC-2-24
11. Seam pieces together using burring rolls.	. SC-2-21
12. Solder seams on inside.	. SC-2-36






RIVETED SIDE SEAM

METHOD OF EVALUATION:

1. Check overall accuracy and appearance of cover.
2. Check for water tightness.

JOB: Make a Portable Ice Chest

UNIT II: Fabrication

COURSE: Metal Fabrication

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-2-45

DRAWING NO: D-2-45 pgs 1 & 2

MATERIAL:
- 24 Gage Galvanized Metal
- 1" Styrofoam
- 3/4 X 1/8" Band Iron
- Screws
- Solder
- Flux
- Rivets
- 1" X 1" Wood Strips

EQUIPMENT:
- Brake
- Shears
- Vise
- Soldering Iron
- Electric Drill
- Hand Drill
- Drill Bits

TOOLS:
- Rule
- Snips
- Scribe
- 8 Point Saw

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Measure and scribe the inner liner body and allow 1/2" for double seam.	
2. Measure and scribe ends for body. Allow 1/4" for flange.	
3. Form body and ends.	
4. Insert ends and double seam.	
5. Solder water tight.	
6. Measure and scribe outer liner.	
7. Form double seam and solder the outer liner.	
8. Cut styrofoam to fit snugly against the inside of the large liner. The bottom piece must fit tight.	
9. Keep the styrofoam down 1" from the top of the liner.	

COMPETENCE - PROCEDURE/STEPS | TEACHING/LEARNING ACTIVITIES

10. Insert the inside liner and push it down until top edges are even. Its bottom should be resting on the styrofoam.

11. Cut 1" X 1" wood strip to fit tightly between the two liners. Drill and screw it fast to the outside.

12. Fabricate and install caps as shown on print detail. Solder these caps securely to the inner and outer liners.

13. Measure, cut and form top and bottom of lid.

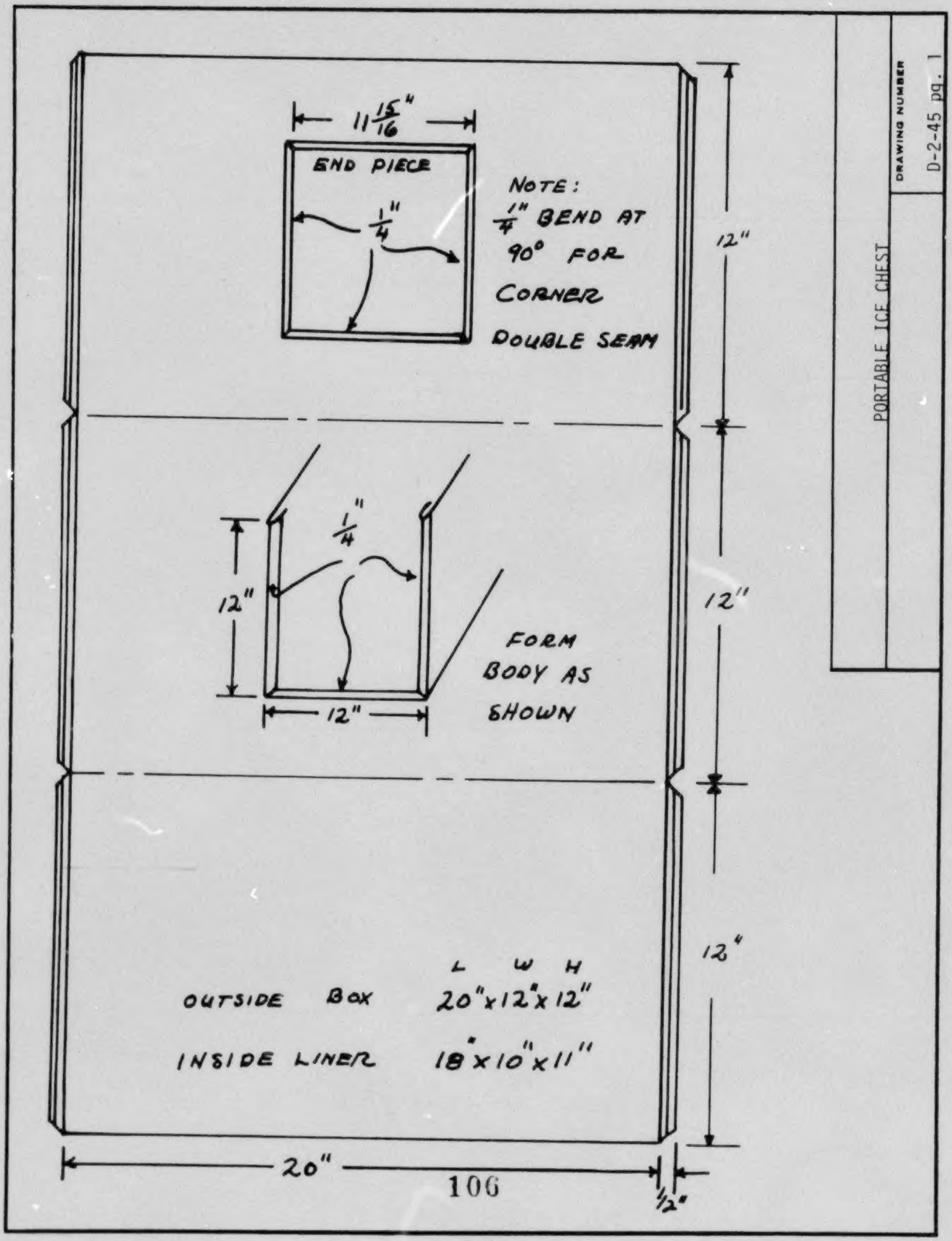
14. Cut and install styrofoam in the bottom part of the lid.

15. Place the top lid piece on the bottom. Bend flanges and squeeze as shown on the lid detail.

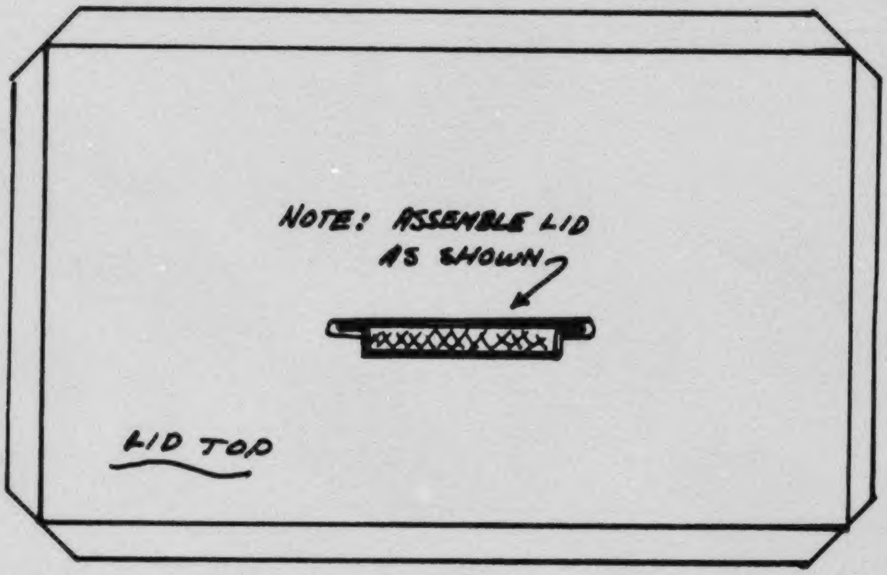
16. Install the lid handle and tote handles.

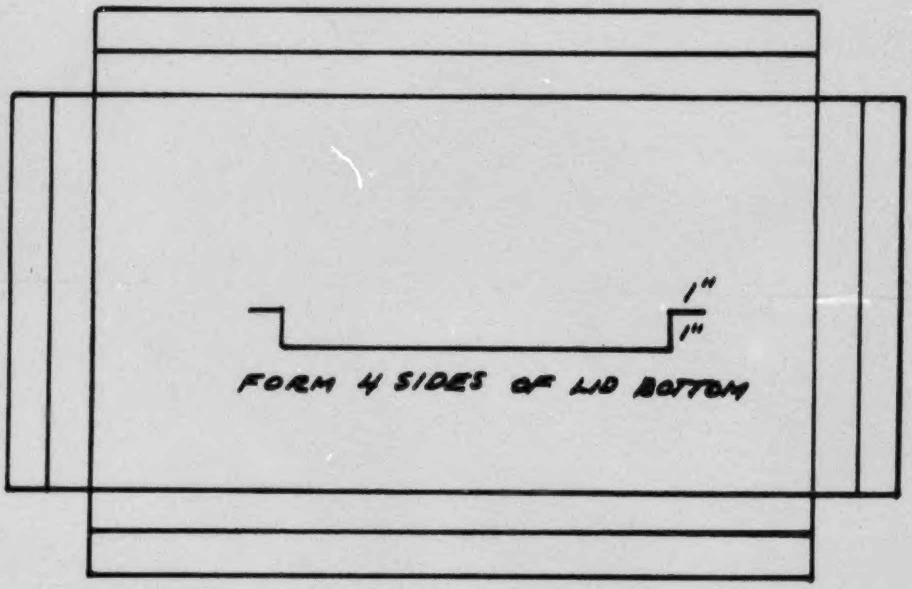
METHOD OF EVALUATION:

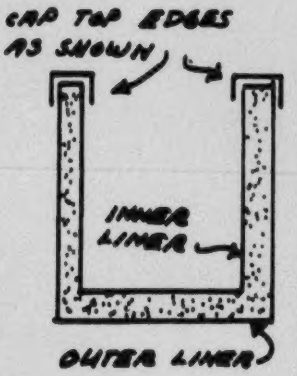
1. Check overall appearance and accuracy of ice chest.
2. Check lid for good tight fit.


11 15/16"
END PIECE
1/4"
NOTE:
1/4" BEND AT
90° FOR
CORNER
DOUBLE SEAM
12"
12"
12"
1/4"
12"
12"
FORM
BODY AS
SHOWN
12"
L W H
OUTSIDE BOX 20"x12"x12"
INSIDE LINER 18"x10"x11"
20"
1/2"
DRAWING NUMBER
D-2-45 pg. 1
PORTABLE ICE CHEST

BOTH LINERS SOLDERED WATER TITE
LID AND 1" SPACE BETWEEN LINERS
FITTED WITH 1" STYROFOAM SHEET


NOTE: ASSEMBLE LID
AS SHOWN
LID TOP


1"
1"
FORM 4 SIDES OF LID BOTTOM


CAP TOP EDGES
AS SHOWN
INNER
LINER
OUTER LINER

PORTABLE ICE CHEST

DRAWING NUMBER
D-2-45 pg. 2

JOB: Make a Duct Transition - 3 Sides Straight

UNIT II: Fabrication

COURSE: Metal Fabrication

MATERIAL: Paper
26 Gage Galvanized Metal

EQUIPMENT: Drawing Equipment
Shears
Brake
Pittsburgh Lock Former

TOOLS: Pencil
Rule
Snips
Hammer
Scribe
Visegrips

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-2-46

DRAWING NO: D-2-46

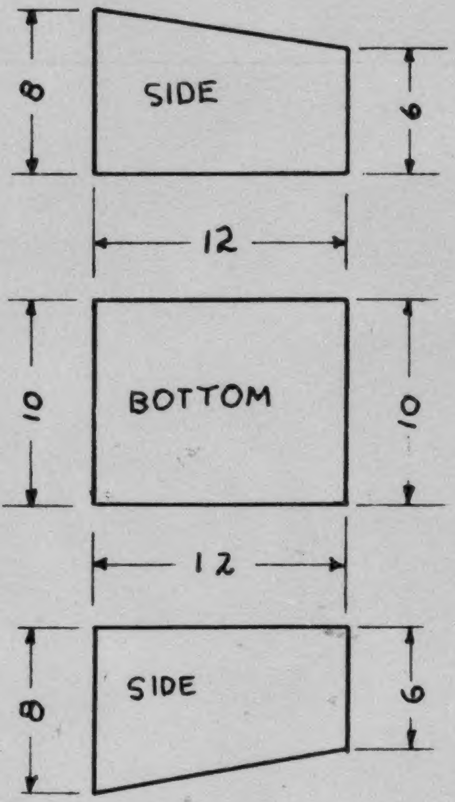
SAFETY PRECAUTIONS:

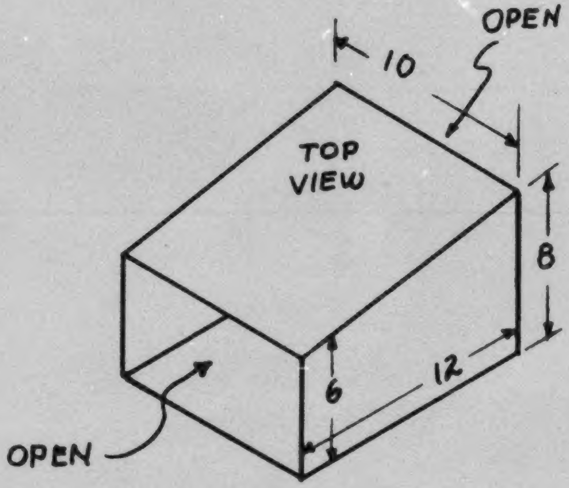
Observe all rules for drawing tool safety, machine safety, material handling safety and tool safety.

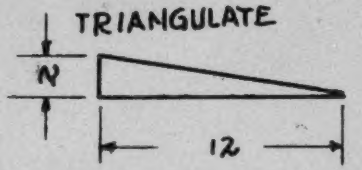
COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Lay out plan and elevation to print dimensions.	Shop and field methods used today to develop patterns of this type duct reducers are used constantly on all heating and ventilating jobs. The metal fabricator must be proficient at making all of them.
2. Lay out top piece.	
3. Triangulate and lay out two side pieces and bottom piece.	
4. Allow for all edges and locks.	
5. Place paper patterns on 26 gage galvanized metal.	
6. Scribe all cut lines unto the metal.	
7. Prick punch all bend marks.	
8. Cut out all pieces.	
9. Form all pieces and notch them.	
10. Assemble all pieces.	NOTE: Do not twist fitting during assembly, all corners must be square.

METHOD OF EVALUATION:

1. Check overall accuracy and appearance of job.
2. Check job against paper patterns.


8
SIDE
6
12
10
BOTTOM
10
12
8
SIDE
6


10
OPEN
TOP
VIEW
8
6
12
OPEN


TRIANGULATE
N
12

TO GET NET LENGTH
OF TOP PIECE

DUCT TRANSITION - 3 SIDES STRAIGHT

DRAWING NUMBER
D-2-46 110

JOB: Make a Duct Transition - 2 Sides Straight

JOB SHEET IDENTIFICATION CODE

UNIT II: Fabrication

JOB NUMBER: J-2-47

COURSE: Metal Fabrication

DRAWING NO: D-2-47

MATERIAL: Paper
26 Gage Galvanized Metal

EQUIPMENT: Drawing Equipment
Shears
Brake
Pittsburgh Lock Former

TOOLS: Pencil
Rule
Hammer
Snips
Visegrips
Scribe

SAFETY PRECAUTIONS:

Safely use all tools, equipment and materials.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Lay out plan and elevation to print dimensions.	
2. Lay out top and bottom piece.	
3. Triangulate and lay out the two side pieces.	
4. Allow for all edges and locks.	
5. Place paper patterns on metal.	
6. Scribe all cut lines onto the metal.	
7. Prick punch all bend marks.	
8. Cut out all pieces and notch them.	
9. Form all pieces.	
10. Assemble all pieces.	

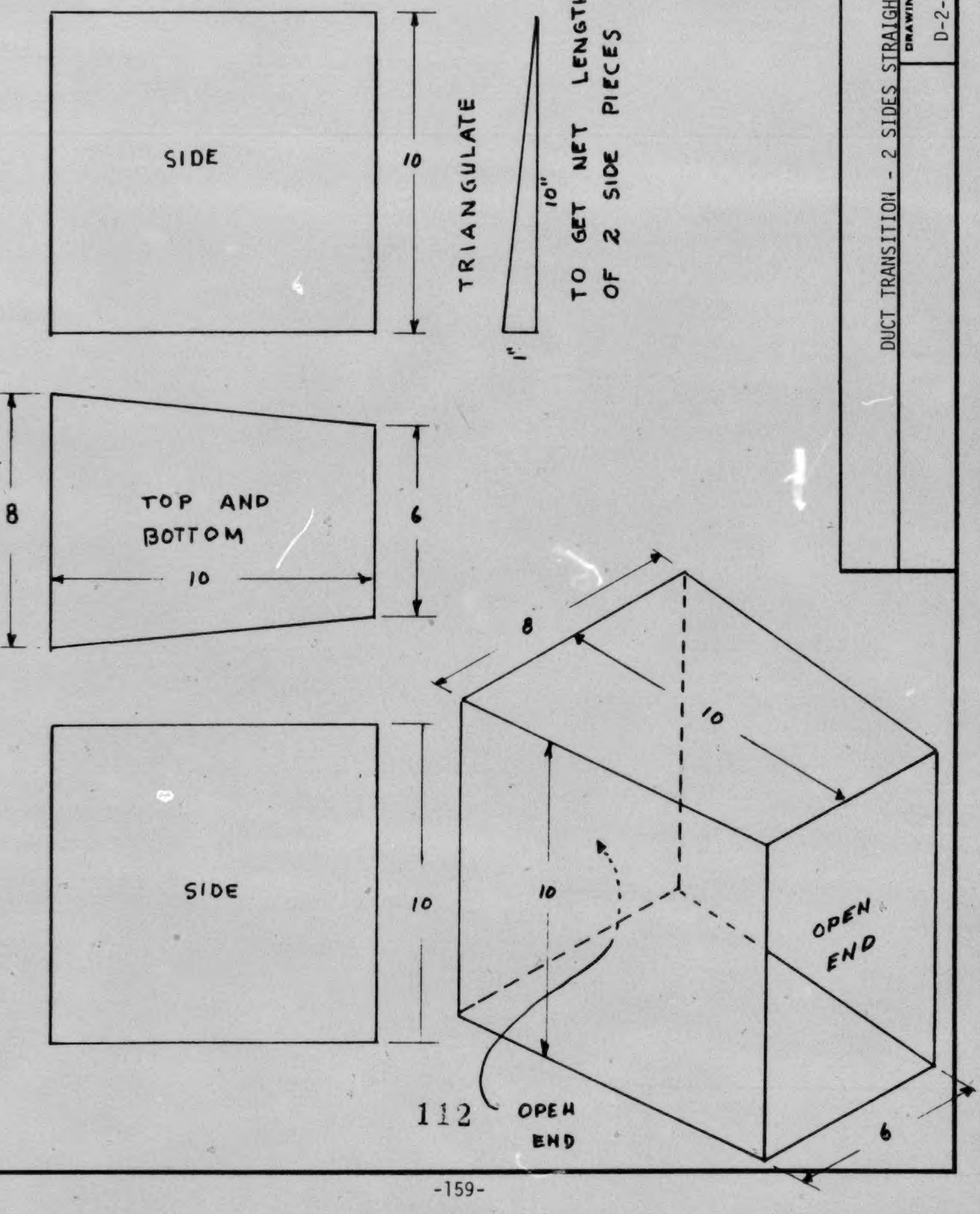
METHOD OF EVALUATION:

1. Check all opening measurements.
2. Check finish length of fitting.
3. Be sure the fitting is not twisted.

DUCT TRANSITION - 2 SIDES STRAIGHT

DRAWING NUMBER

D-2-47


SIDE
10
TRIANGULATE
1"
10"
TO GET NET LENGTH
OF 2 SIDE PIECES
8
TOP AND
BOTTOM
10
6
SIDE
10
8
10
10
OPEN
END
OPEN
END
6

112

JOB: Make a Duct Transition - 1 Side Straight

JOB SHEET
IDENTIFICATION CODE

UNIT II: Fabrication

JOB NUMBER: J-2-48

COURSE: Metal Fabrication

DRAWING NO.: D-2-48

MATERIAL: Paper
26 Gage Galvanized

EQUIPMENT: Drawing Equipment
Power Shears
Brake
Pittsburgh Lock Former

TOOLS: Pencil
Rule
Snips
Vice grips
Hammer
Scriber

SAFETY PRECAUTIONS:

Observe all material safety, tool safety, and overall shop safety rules.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Layout plan and elevation to print dimensions.	
2. Layout pattern for straight side.	
3. Triangulate and then layout patterns for 3 pitched sides.	
4. Place paper patterns on metal.	
5. Scribe and punch all cut and bend lines.	
6. Cut out all pieces.	
7. Notch all pieces.	
8. Form all locks, flanges and bends.	
9. Assemble the pieces in the proper position.	
10. Check completed fitting for size and squareness.	

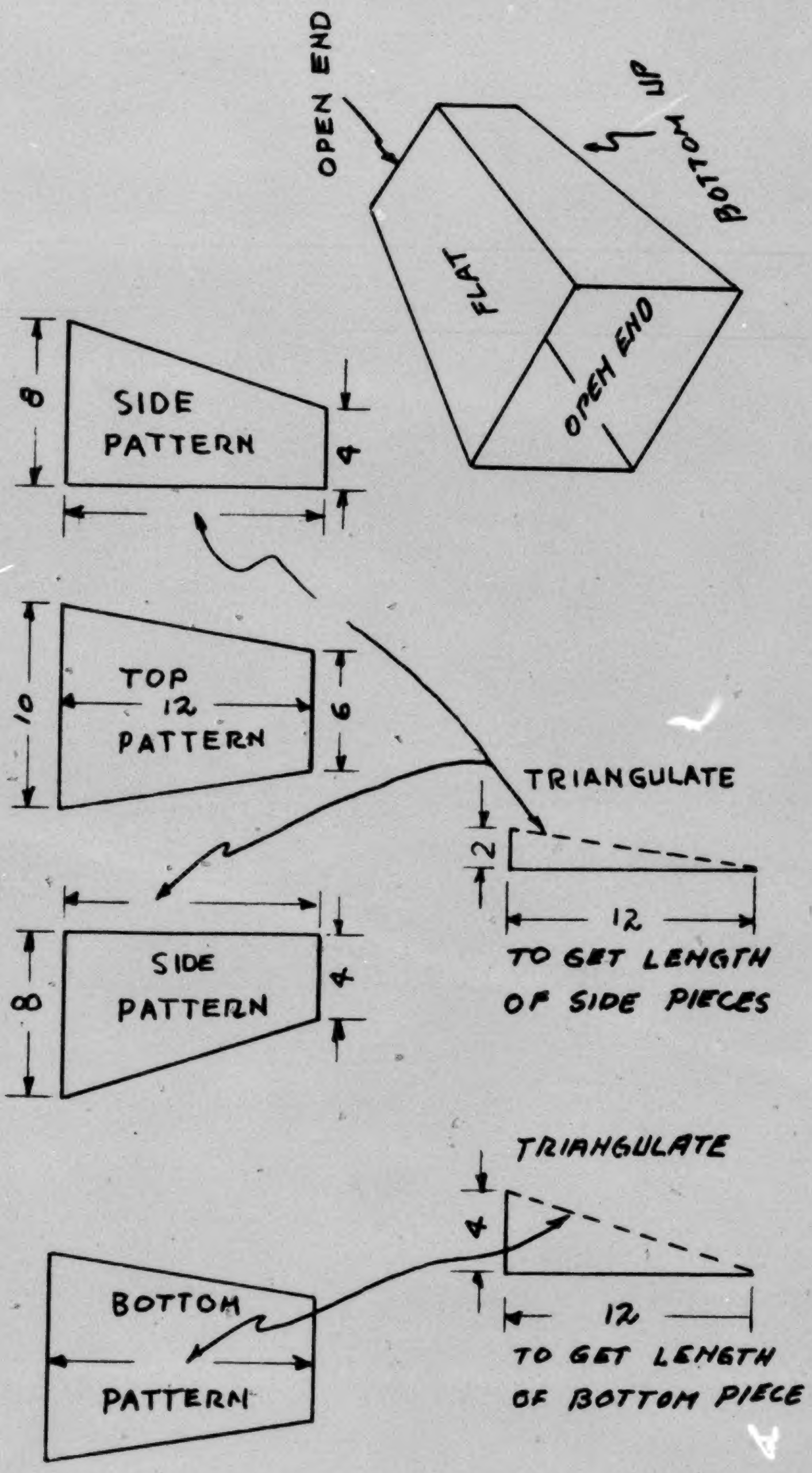
METHOD OF EVALUATION:

Check fitting against the paper patterns for accuracy.

DUCT TRANSITION - 1 SIDE STRAIGHT

DRAWING NUMBER

D-2-48


OPEN END
BOTTOM UP
FLAT
OPEN END
SIDE PATTERN
8
4
TOP PATTERN
10
12
6
TRIANGULATE
2
12
TO GET LENGTH OF SIDE PIECES
SIDE PATTERN
8
4
TRIANGULATE
4
12
TO GET LENGTH OF BOTTOM PIECE
BOTTOM PATTERN

JOB: Make a Square to Round Transition - Centered

JOB SHEET IDENTIFICATION CODE

UNIT II: Fabrication

JOB NUMBER: J-2-49

COURSE: Metal Fabrication

MATERIAL: Paper
26 Gage Galvanized Metal

EQUIPMENT: Drawing Equipment
Shears
Brake

TOOLS: Hammer
Scribe
Rule
Pencil
Pencil
Hand Groover
Snips
Center Punch

SAFETY PRECAUTIONS:

Use all shop safety precautions.

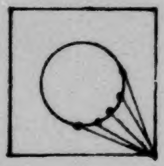
COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

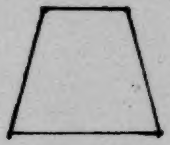
---

1. Layout plan and elevation.
2. Get true length lines.
3. Project to obtain working pattern, full pattern.
4. Place paper pattern on metal.
5. Scribe all outside cut lines.
6. Punch all bend lines.
7. Cut out metal.
8. Bend seams.
9. Make necessary bends on each punch mark until desired shape is achieved.
10. Place on stake and groove with hand groover and hammer.

PLAN



ELEVATION



METHOD OF EVALUATION:

1. Check all measurements.
2. Fitting must set flat and maintain the finished vertical height called for on the drawing.

JOB: Make Rectangular To Round Transition - Centered

JOB SHEET IDENTIFICATION CODE

UNIT II: Fabrication

JOB NUMBER: J-2-50

COURSE: Metal Fabrication

DRAWING NO.: D-2-50

MATERIAL: Paper
24 Gage Galvanized Metal

EQUIPMENT:
Drawing Equipment
Shears
Cornice Brake

TOOLS:
Pencil
Rule
Snips
Hand Groover
Scribe
Dividers
Hammer

SAFETY PRECAUTIONS:

Be careful of eye safety, bench cleanliness, and material safety.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Draw plan and elevation.	
2. Obtain all true length lines.	
3. Project to obtain 1/2 pattern.	
4. Add for all seams and connectors.	
5. Place paper pattern on metal and transfer all cut lines and bend lines to metal.	
6. Cut out this metal 1/2 pattern.	
7. Trace one more half pattern from the metal pattern.	
8. Cut out second piece of brick. Punch all bends.	
9. Bend groove seams.	
10. Make bends on punch marks until desired shape is obtained.	

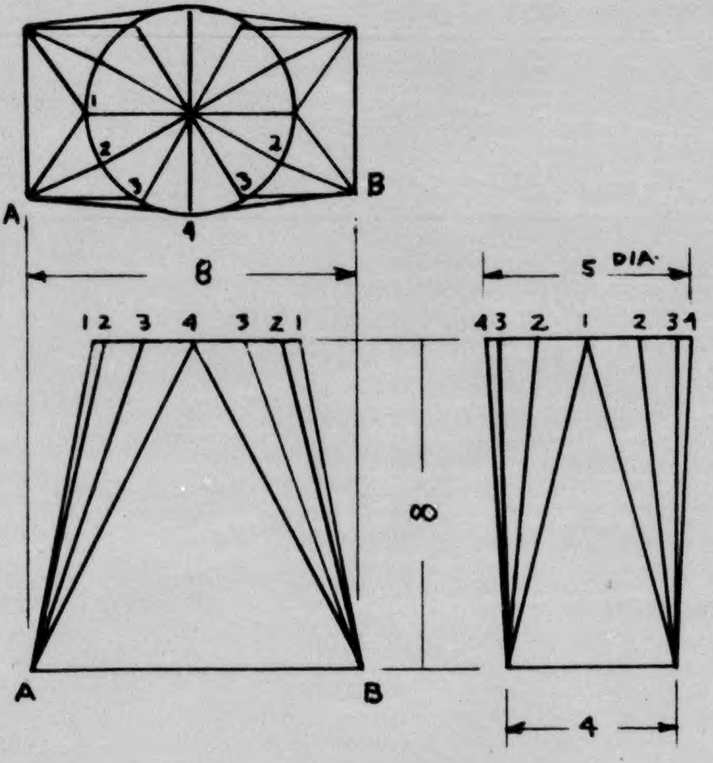
COMPETENCE - PROCEDURE/STEPS TEACHING/LEARNING ACTIVITIES

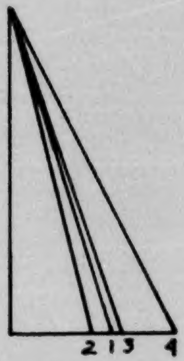
11. Groove the two pieces together.

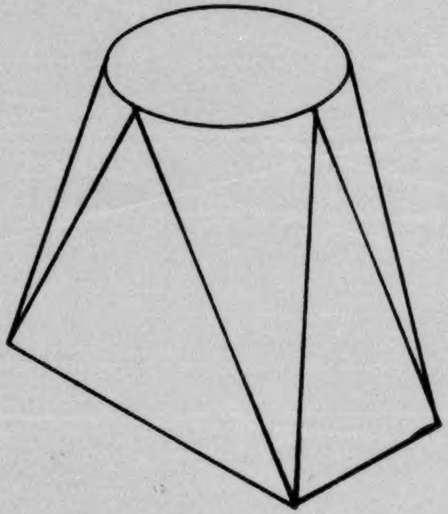
12. Check fitting for accuracy.

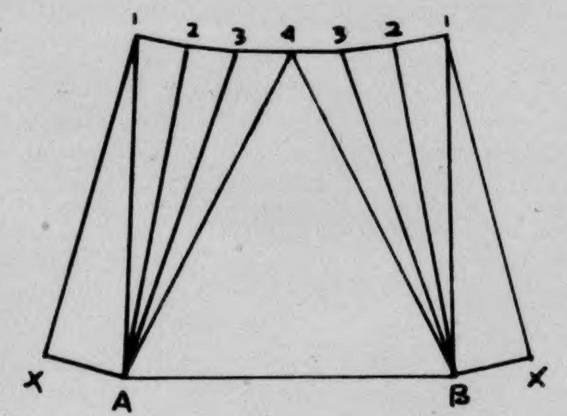
METHOD OF EVALUATION:

Is this fitting made good enough to sell to a prospective customer?


A
B
1
2
3
4
2
3
8
5 DIA
1 2 3 4 3 2 1
4 3 2 1 2 3 4
8
4
A
B






1 2 3 4 3 2 1
X
A
B
X

RECTANGULAR TO ROUND TRANSITION - CENTERED

DRAWING NUMBER

D-2-50

JOB: Make a Rectangular to Round Transition - Off Center

JOB SHEET IDENTIFICATION CODE

UNIT II: Fabrication

JOB NUMBER: J-2-51

COURSE: Metal Fabrication

DRAWING NO.: D-2-51

MATERIAL:
Paper
1/16" Weld Rod
18 Gage Cold Rolled

EQUIPMENT:
Drawing Tools
Shears
Brake
Uni-Shears
Oxy-Acetylene Unit

TOOLS:
Rule
Scribe
Pencil
Prick Punch
Vice Grips
Snips
Hammer

SAFETY PRECAUTIONS:

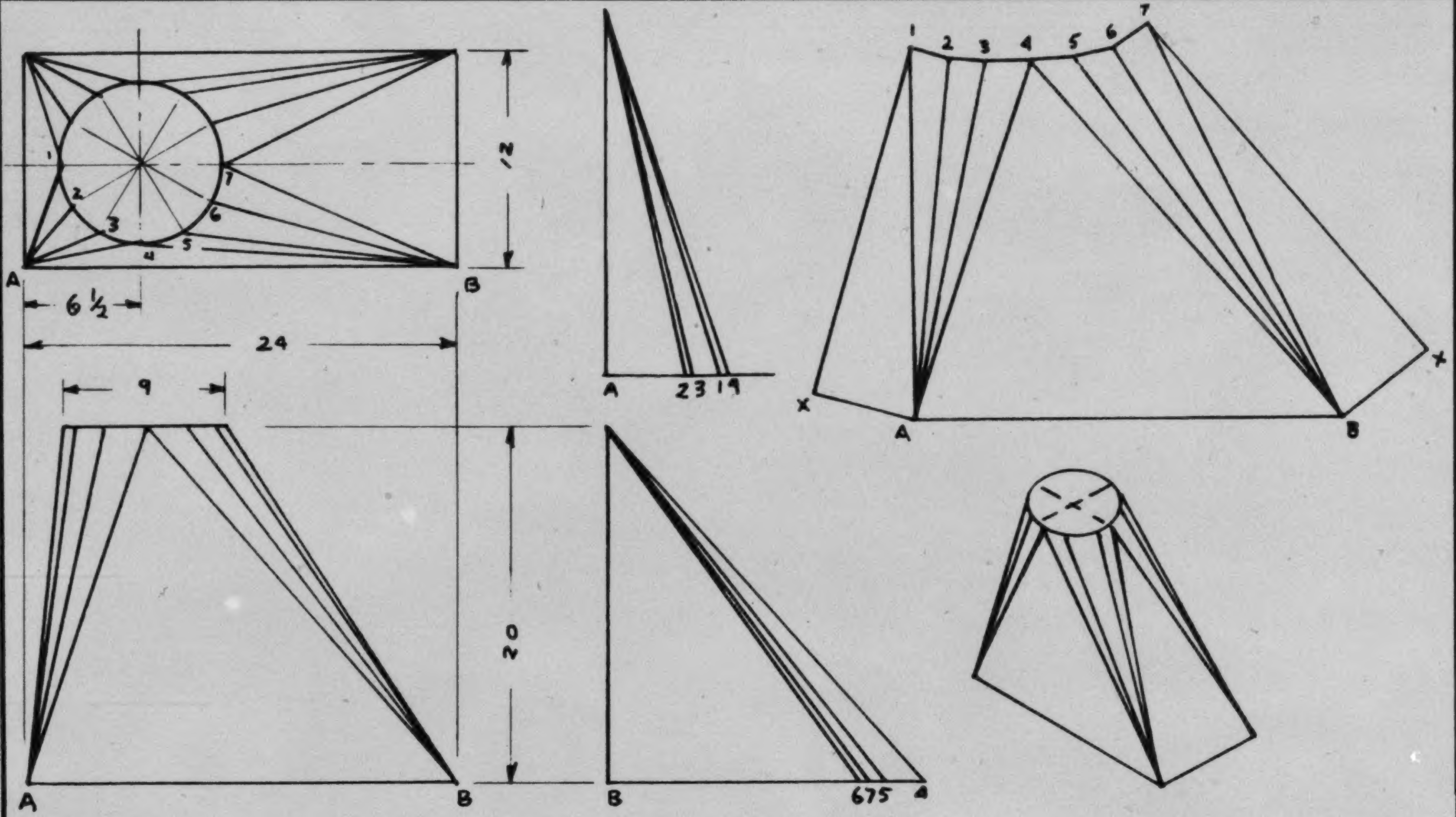
Use power tools properly. Safety goggles must be worn. Use necessary protective equipment when welding. NO-HORSE PLAY.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Layout plan and elevation.	
2. Obtain 4 sets of true length lines.	
3. Layout pattern in two pieces, (X-A-B-X) and (X-D-C-X).	
4. Place paper patterns on metal.	
5. Scribe all cut lines.	
6. Prick punch all bend lines.	
7. Allow 3/16" at seams and bend out 90°.	
8. Bend the two pieces to their proper shape.	
9. Clamp together at the standing edges.	
10. Fuse together with the oxy-acetylene torch.	
11. Check project for neatness and accuracy.	

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES

METHOD OF EVALUATION:

1. Check for overall appearance and accuracy of job.
2. Check job against paper patterns.


1
2
3
4
5
6
7
A
B
6 1/2
24
12
9
20
A
B
A
2 3 1 9
B
6 7 5 4
1
2
3
4
5
6
7
X
A
B
X

RECTANGULAR TO ROUND TRANSITION - OFF CENTER

DRAWING NUMBER

D-2-51

JOB: Three Piece 90^{0} Tapering Elbow

UNIT II: Fabrication

COURSE: Metal Fabrication

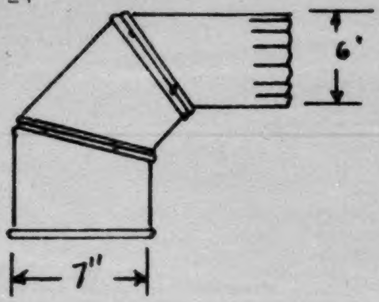
MATERIAL: Pattern of Elbow from Drafting Unit
20 Gage Galvanized Steel
3 Pound Rivets

EQUIPMENT: Squaring Shear
Unishear
Slip Roll Former

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-2-52

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Apply pattern from pattern drafting unit, scribe outline and prick punch rivet centers.	. SC-1-1, SC-2-2, SC-2-4
2. Cut straight cuts with foot shears.	. SC-2-14
3. Cut curved cuts with unishear.	. SC-2-50
4. Notch corners at seams.	. SC-2-6
5. Punch rivet holes with hand punch.	. SC-2-23
6. Roll pieces on slip roll former.	. SC-2-16
7. Rivet side seams on each piece.	. SC-2-24
8. Assemble pieces and rivet together.	. SC-2-24



METHOD OF EVALUATION:

1. Check for correctness of 90^{0} angle.
2. Check finished elbow against paper patterns.

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-2-53

JOB: Make An Outside Barbecue Grill

UNIT II: Fabrication

COURSE: Metal Fabrication

MATERIAL:
5/8" Round Rod
Weld Rod
3/4" Pipe
1" Pipe
1/2" Round Rod
5/8" Nut

EQUIPMENT:
Electric and Gas Welders
Taps and Dies
Vise
Disc Sander
Band Power Saw
Grinder
Drill Press

TOOLS:
Rule
Scribe
Hack Saw
Hammer
Files

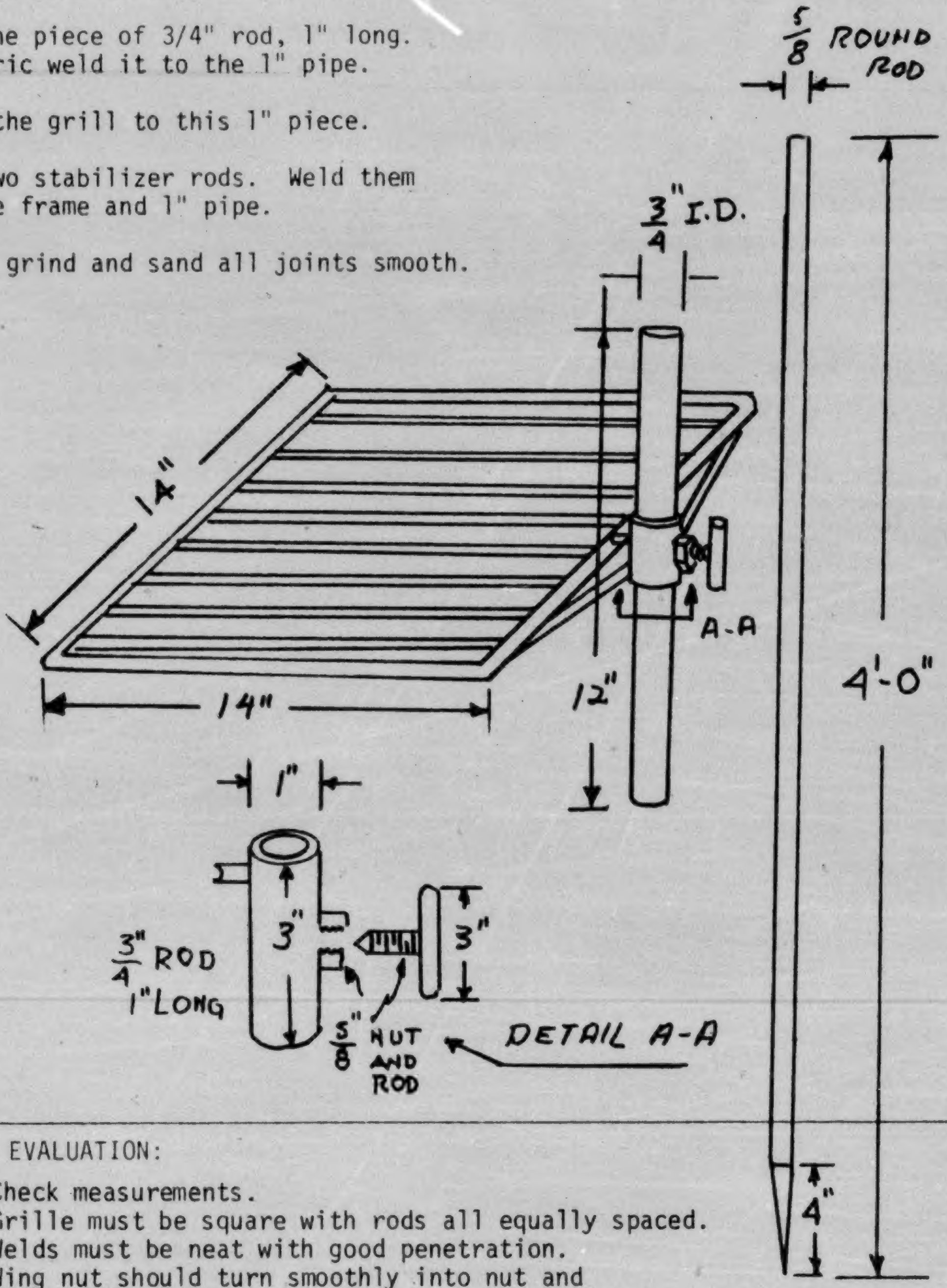
COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Cut 1 piece of 5/8" rod, 48" long. Taper the bottom as shown on the print.	
2. Cut one piece of 1/2" rod, 56" long.	
3. Mark and bend it to print specifications.	
4. Cut 8 pieces of 1/2" rod, 14" long. Space them equally through grill frame and weld.	
5. Cut one piece of 3/4" inside diameter pipe 12" long.	
6. Drill one 5/8" diameter hole in the center of the 12" length. (Drill through one wall only.)	
7. Cut 1 piece of 1" inside diameter pipe 3" long. Drill a 3/4" diameter hole through one wall.	
8. Braze a 5/8" standard thread nut to this piece.	NOTE: Be sure nut is centered over hole.
9. Fabricate and thread a 5/8" diameter wingnut as shown on print detail.	

10. Cut one piece of 3/4" rod, 1" long. Electric weld it to the 1" pipe.

11. Weld the grill to this 1" piece.

12. Cut two stabilizer rods. Weld them to the frame and 1" pipe.

13. File, grind and sand all joints smooth.



$\frac{5}{8}$ ROUND ROD
$\frac{3}{4}$" I.D.
14"
14"
12"
A-A
4'-0"
1"
3"
3"
$\frac{3}{4}$" ROD 1" LONG
$\frac{5}{8}$" NUT AND ROD
DETAIL A-A
4"

METHOD OF EVALUATION:

1. Check measurements.
2. Grille must be square with rods all equally spaced.
3. Welds must be neat with good penetration.
4. Wing nut should turn smoothly into nut and tightly hold unit in position.

JOB: Make a Slant Legged Coffee Table

JOB SHEET IDENTIFICATION CODE

UNIT II: Fabrication

JOB NUMBER: J-2-54

COURSE: Metal Fabrication

DRAWING NO: D-2-54 pgs 1 & 2

MATERIAL:
3/4" X 3/4" X 1/8" Angle Iron
1/2" X 1/2" X 1/8" Angle Iron
1/2" X 1/2" X 1/16" Angles
1/4" X 10" X 26" Plate Glass
Cane Metal
1/2" Round Rod
1/2" Plywood
Formica
Paint
Formica Cement

EQUIPMENT:
Band Saw
Sabre Saw
Oxy-Acetylene Welding Unit
Mild Steel Weld Rod
Disc Sander
Floor Grinder

TOOLS:
Files
Rule
Hammer
Vise Grips

SAFETY PRECAUTIONS:

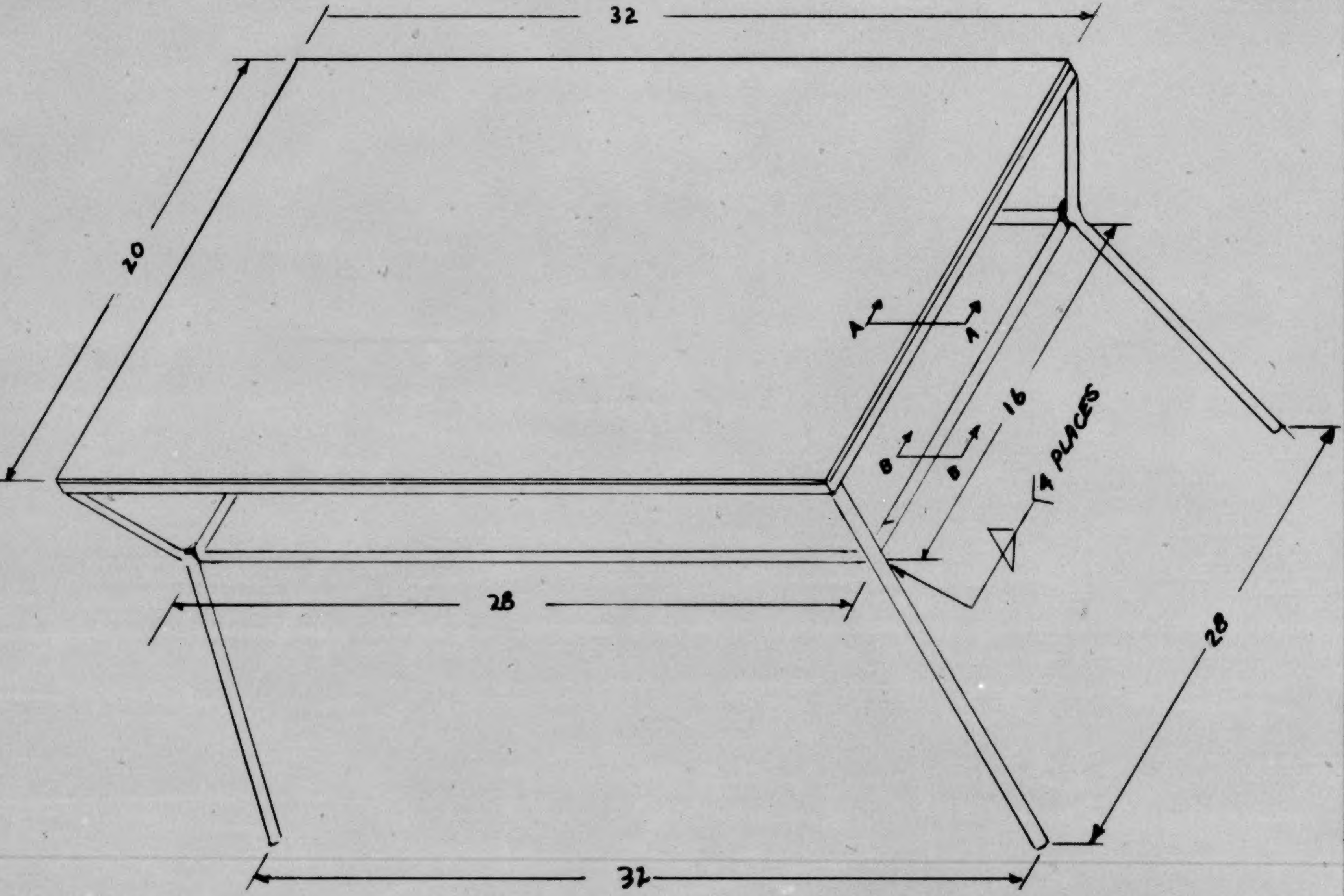
Observe welding, cutting and forming shop safety rules.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. For the top frame, cut 3/4" angle (mitered corners web inside) according to print measurements.	
2. For the bottom frame, cut 1/2" angle.	
3. Cut the four pieces of 1/2" rod.	
4. Form the 1/2" rods to the proper angle.	
5. Weld the frames and grind them smooth.	
6. Clamp top and bottom frames to legs and weld them, file and grind them smooth.	
7. Cut a piece of cane metal to fit the inside bottom frame.	
8. Tack braze cane metal to frame.	
9. Have plywood cut so it is exactly flush with the inside of the top frame.	
10. Cut a hole in the plywood 10" X 26".	
11. Fasten 1/2" X 1/16" angles to plywood.	

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
12. Sand all wood edges smooth.	
13. Prime and finish paint wood and metal.	
14. Insert glass (1/4" X 10" X 26") into plywood opening.	
15. Check finished job.	

METHOD OF EVALUATION:

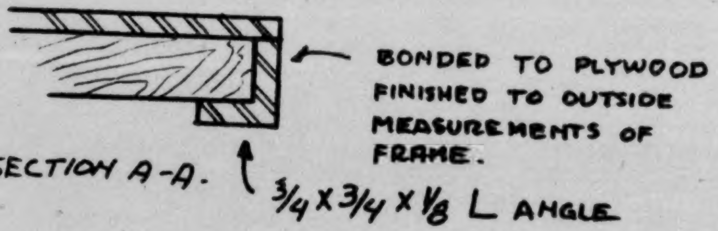
Check for overall accuracy and appearance of finished table.


32
20
A
A
16
B
B
4 PLACES
28
28
32

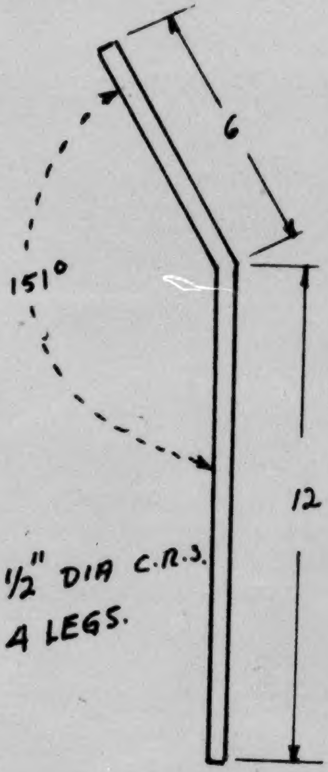
SLANT LEGGED COFFEE TABLE

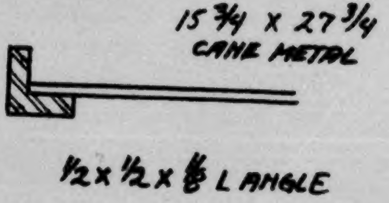
DRAWING NUMBER

D-2-54 pg. 1


BONDED TO PLYWOOD FINISHED TO OUTSIDE MEASUREMENTS OF FRAME.
3/4 X 3/4 X 1/8 L ANGLE

SECTION A-A.


6
151°
12
1/2" DIA C.R.S.
4 LEGS.


15 3/4 X 27 3/4
CANE METAL
1/2 X 1/2 X 1/8 L ANGLE

SECTION B-B

SLANT LEGGED COFFEE TABLE

DRAWING NUMBER

D-2-54 pg. 2

JOB: Heavy Conical Jack Stand

UNIT II: Fabrication

COURSE: Metal Fabrication

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-2-55

MATERIAL:
- 1/4" Hot Rolled Plate
- 1/4" X 2" Band Iron
- 2-1/2" Pipe
- 2" Pipe
- Weld Rods E6013
- 1/2" Rod

EQUIPMENT:
- Oxy-Acetylene Cutting Torch
- Electric Welder
- Band Saw
- Grinder
- Drill Press
- Vise

TOOLS:
- Rule
- Scribe
- Punch
- Soapstone
- Square
- 1/2" Drill Bit
- Slag Hammer

SAFETY PRECAUTIONS:

1. Observe burning safety rules.
2. Observe welding safety rules.
3. Observe grinding safety rules.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

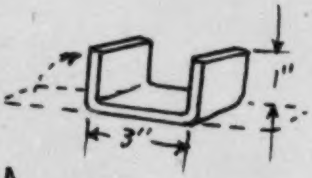
1. Cut 1 piece 2-1/2" black pipe 12" long.

2. Cut 1 piece 2" pipe 15" long.

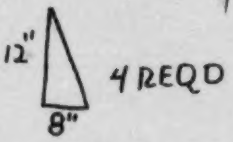
3. If necessary have outside of 2" pipe machined so it slips into 2-1/2" pipe.

4. Cut 1 piece 1/4" X 2" band iron 5" long.

5. Mark and form band iron into shape as shown.



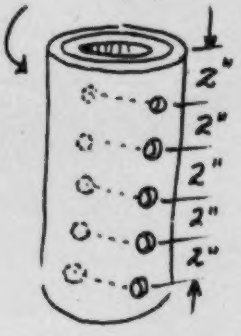
6. Mark and burn 4 pieces 1/4" plate as shown.



7. Insert 2" pipe into 2-1/2" pipe bottoms flush.

8. Mark and drill 1/2" holes as shown.

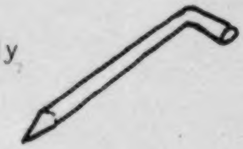
NOTE: Holes must go completely through both sides of pipe.



9. Cut 2 pieces 1/2" round rod 10" long.

10. Heat and form into angle 90°.

11. Taper the 6" end so it can be easily started through the holes.

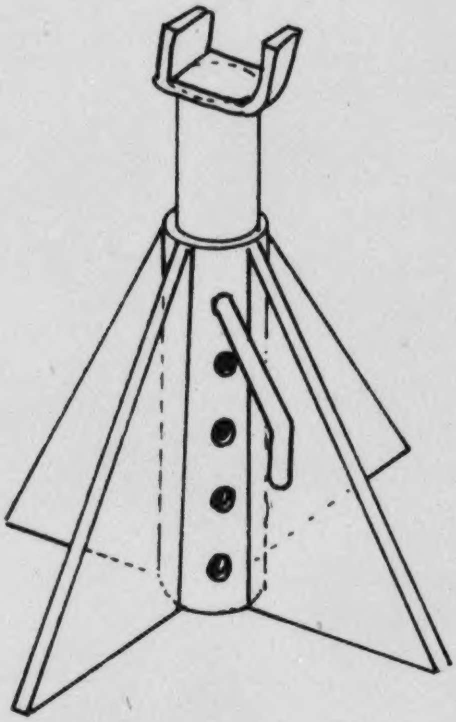


COMPETENCE - PROCEDURE/STEPS | TEACHING/LEARNING ACTIVITIES

12. Equally space 4-1/4" plates on 2½" pipe, weld with arc welder.

13. Weld 1/4" X 2" ⊔ channel to top of 2" pipe.

14. Grind and smooth all edges and welds.



METHOD OF EVALUATION:

1. Check alignment of holes between the base and the inner pipe.
2. Check for soundness and smoothness of welds.

JOB: Transport Cylinders

UNIT III: Welding

COURSE: Metal Fabrication

EQUIPMENT: Oxygen-Acetylene Cylinders
Tank Cart

TOOLS: Wrench
Slip Joint Pliers

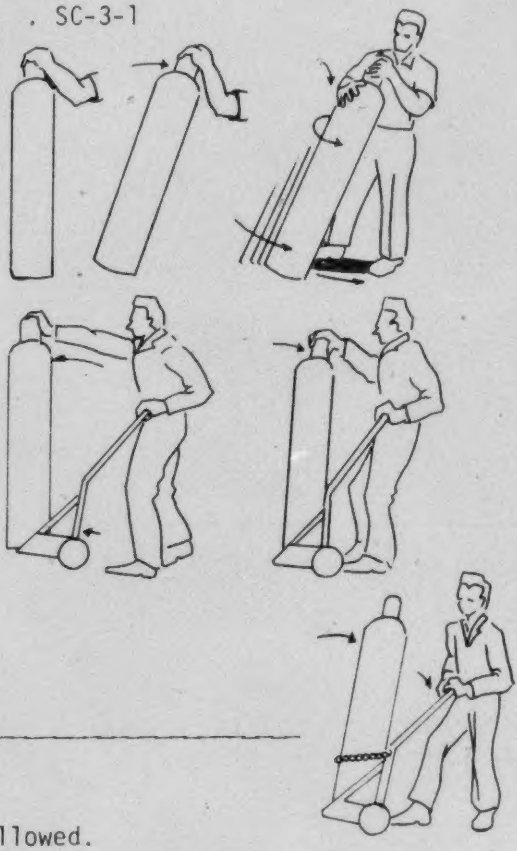
JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-3-1

SAFETY PRECAUTIONS:

Never move tanks unless caps are turned on securely, do not drop tanks.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Check tank caps make sure they are on the tanks securely.	. SC-3-1
2. Lift tanks onto cart.	
3. Secure tanks to the cart by chaining them to the cart body.	
4. Move them to the location you plan to be working.	



METHOD OF EVALUATION:

1. Check that all safety procedures are followed.
2. Check for angle of tank and placement of hands on the tank.

JOB: Assemble Hoses and Equipment

JOB SHEET
IDENTIFICATION CODE

UNIT III: Welding

JOB NUMBER: J-3-2

COURSE: Metal Fabrication

EQUIPMENT: Cart Hoses
Tanks Gages Blow Pipe Assembly

TOOLS: Wrenches

SAFETY PRECAUTIONS:

1. Make sure tanks are secure.
2. Never use oil on any connections.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Remove the cap from the oxygen tank. Open the valve slightly to clean out any dirt that may be in the tank port.	. SC-3-1, SC-3-2
2. Install oxygen gages to tank, green hose to gages, and green hose to oxygen blow pipe.	NOTE: All oxygen threads are right hand.
3. Open acetylene tank valve with key and clear tank port of dirt.	
4. Install acetylene gage to tank fitting, install acetylene hose to gage (normally red) and hose fitting to blow pipe, tighten with wrenches.	NOTE: All acetylene fittings are left hand threaded.

METHOD OF EVALUATION:

1. Check that tanks were blown off.
2. Check for any wrong connections.

JOB: Open and Adjust Gas Pressures

UNIT III: Welding

COURSE: Metal Fabrication

EQUIPMENT: Complete Oxy-Acetylene Welding Unit

SAFETY PRECAUTIONS:

Observe all safety rules while handling regulators.

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-3-3

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Open oxygen tank valve fully. The Diaphragm Regulating Knob should be completely out at this time.	. SC-3-1 thru SC-3-3
2. Read the tank pressure.	
3. Open the oxygen blow pipe valve.	
4. Turn oxygen diaphragm regulator to right until hose pressure reads 10 lbs.	
5. Close oxygen blow pipe valve.	
6. Open acetylene tank valve ¼ turn.	
7. Read tank pressure.	
8. Open acetylene blow pipe valve.	
9. Turn acetylene diaphragm regulator to right until hose pressure reads 5 lbs.	
10. Close acetylene blow pipe valve.	
11. Check all connections for leaks.	

METHOD OF EVALUATION:

Check for leaks.

JOB: Light, Adjust and Close Torch

UNIT III: Welding

COURSE: Metal Fabrication

EQUIPMENT: Oxy-Acetylene Welding Outfit

TOOLS: Striker

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-3-4

SAFETY PRECAUTIONS:

1. Be sure you are wearing goggles.
2. Never point torch tip toward people.
3. Never point torch tip toward tanks when you are lighting it.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Open acetylene blow pipe valve.	. SC-3-4, SC-3-5
2. Hold striker in your left hand, blow pipe in your right hand. Squeeze the striker until the acetylene gas ignites. (It will be flame red and dirty.)	
3. Slowly open oxygen blow pipe until flame becomes a deep blue and is clean burning.	
4. Adjust until a neutral flame is established.	
5. Close acetylene blow pipe valve.	
6. After flame is blown out by oxygen, close oxygen blow pipe valve.	

METHOD OF EVALUATION:

1. Check for proper lighting procedure.
2. Check to be sure flame is neutral.

JOB: Clean Torch Tip

UNIT III: Welding

COURSE: Metal Fabrication

EQUIPMENT: Welding Blow Pipe and Tips

TOOLS: Set of Tip Cleaners

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-3-5

SAFETY PRECAUTIONS:

Be careful - use the proper size tip and do not break off the cleaner in the tip.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select the proper size tip cleaner for the size tip to be cleaned.	. SC-3-6
2. Slowly insert cleaner tip into the tip orifice.	
3. Work the cleaner into the tip, back it out several times until the opening is perfectly clean.	
4. Make sure no metal or dirt is still adhering to the tip face.	
5. Light and adjust to see if the flame is correct.	

METHOD OF EVALUATION:

Check cleaned tip for proper cleaning techniques.

JOB: Fusion Weld with No Rod

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-3-6

UNIT III: Welding

COURSE: Metal Fabrication

MATERIAL: 2 Pcs 1/16" Cold Rolled Steel (3" X 6")

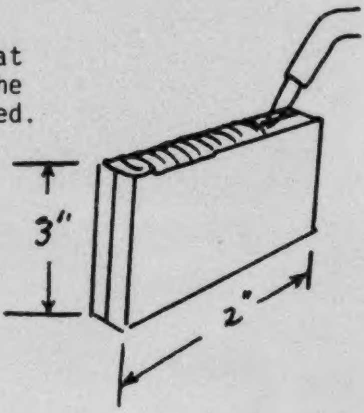
EQUIPMENT: Oxy-Acetylene Welding Unit

TOOLS: Vise or Vise Grips

SAFETY PRECAUTIONS:

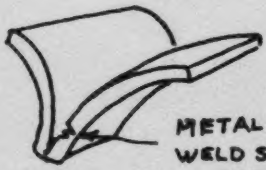
1. Observe safety rules when using torch.
2. Wear all necessary protective gear.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Clamp 2 pieces of 16 gage together.	. SC-3-3 thru SC-3-7
2. Light and adjust flame to neutral.	
3. Holding the flame almost perpendicular to edges of metal and approximately ¼" above metal, heat and melt until base metals fuse together.	
4. With a steady weave motion across flat of joint continue to melt and fuse the metal until the entire joint is welded.	
5. Check for uniformity of bead and penetration.	



METHOD OF EVALUATION:

Place joint in vise. Spread and hammer the metal, the joint should not break at the weld.



METAL SHOULD BREAK.
WELD SHOULD HOLD.

JOB: Fusion Weld with Rod

UNIT III: Welding

COURSE: Metal Fabrication

MATERIAL: (2) Pcs (3" X 6") 1/16" Cold Rolled Steel - 1/16" Mild Steel Rod

EQUIPMENT: Oxy-Acetylene Welding Unit

TOOLS: Vise or Vise Grips

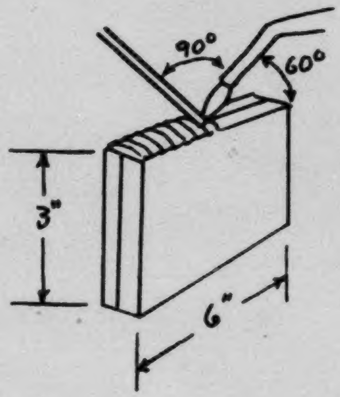
JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-3-7

SAFETY PRECAUTIONS:

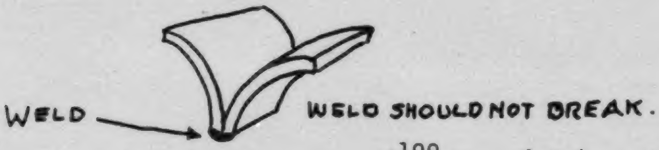
1. Wear necessary safety and protective equipment.
2. Do not weld near combustible materials.
3. Ventilate the area.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Place 1/16" metal in position to weld.	. SC-3-3, SC-3-4, SC-3-6, SC-3-8
2. Light and adjust the torch to neutral flame.	
3. Apply heat to the left side of the joint until it begins to melt.	
4. Insert rod into flame, melt rod into molten puddle or base metal.	
5. Weave torch and rod in a steady motion across base metal.	
6. Build up bead approximately 1/16" above base metal and completely across joint.	
7. Check weld for uniformity of penetration and bead.	



METHOD OF EVALUATION:

Use hammer and chisel to check strength of weld.



JOB: Three Inch Welded Cube

UNIT III: Welding

COURSE: Metal Fabrication

MATERIAL: 16 Gage Hot Rolled Steel
Gas Welding Rod

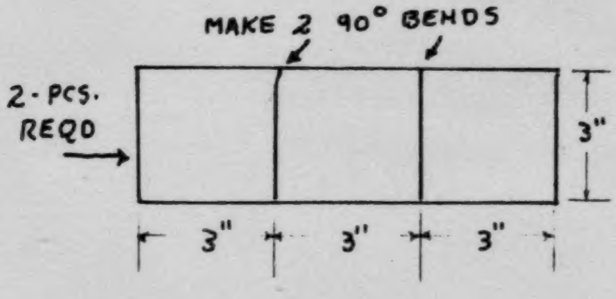
EQUIPMENT: Press Brake
Unishear
Oxy-Acetylene Welding Equipment

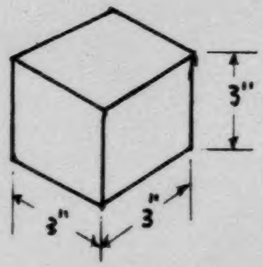
TOOLS: Rule
Scribe
Burring Tool

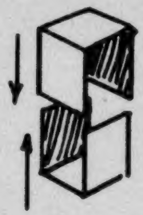
JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-3-8

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Lay out a two piece cube using a rule and scribe.	. SC-1-1, SC-2-2
2. Cut out with unishear.	. SC-2-50
3. Bend two 90° bends on each piece with press brake.	. SC-2-42
4. Remove all burrs.	. SC-2-45
5. Align pieces on each other forming a cube.	
6. Use the oxy-acetylene welding equipment to weld all edges where pieces make contact.	. SC-3-3 thru SC-3-6, SC-3-8







METHOD OF EVALUATION:

Check cube for air tightness. 142

JOB: Tie Rack

UNIT III: Welding

COURSE: Metal Fabrication

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-3-9

MATERIAL: (3" X 10") 1/8" Cold Rolled Steel
4Pcs - 4"Long 1/4" Round Rod
1/8" Brazing Rod
Flux

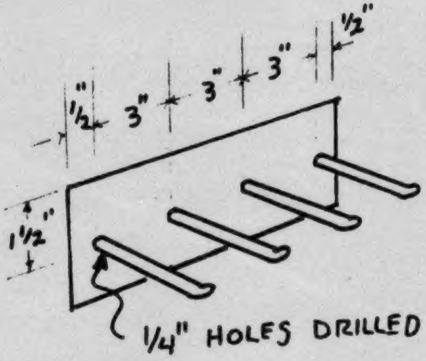
EQUIPMENT: Oxy-acetylene Welding Unit
4' Power Shear
Bench Vise
Grinder

TOOLS: Hacksaw
Scratch Awl
Rule
Hammer

SAFETY PRECAUTIONS:

1. Wear protective equipment.
2. Have good ventilation.
3. Do not weld near anything that will burn or explode.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Set up 1/8" X 3" X 10" plate and insert (4) ¼" rods into holes as shown.	. SC-3-3 thru SC-3-6, SC-3-9
2. Light and adjust torch (neutral flame).	
3. Heat brass rod. Insert rod into flux until flux adheres to rod.	
4. Apply heat to plate and ¼" rod until both pieces become dull red.	
5. Place brazing rod into flame at joint and melt the brass rod until it freely flows into the joint.	
6. Manipulate flame and rod to make even uniform bead.	
7. Clean glaze flux from weld and check brazed joint for uniformity.	



METHOD OF EVALUATION:

Check all brazed joints for good appearance and adhesion.

JOB: Torch Solder Double Seam Bottom

JOB SHEET
IDENTIFICATION CODE

UNIT III: Welding

JOB NUMBER: J-3-10

COURSE: Metal Fabrication

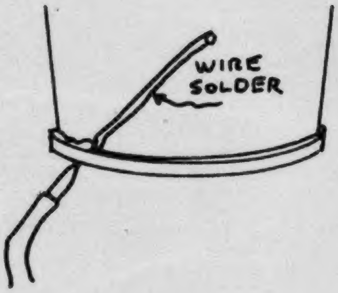
MATERIAL: 24 Gage Galvanized Metal
50/50 Solder
Flux
Flux Brush

EQUIPMENT: Welding Torch or Prestolite Torch

SAFETY PRECAUTIONS:

Use safety goggles and gloves.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Position job #18 - pail with double seam bottom - on the soldering table.	. SC-2-36A
2. Flux the entire bottom joint with paste flux.	. SC-3-10
3. Light and adjust the prestolite torch, flame should be quiet and not too large.	
4. Heat seam by applying heat to bottom of joint.	
5. Melt 50/50 wire solder into top of double seam until the capillary attraction pulls liquid solder completely down into joint.	
6. Continue manuvering heat until entire double seam has been soldered.	
7. Fill pail with water and check for leaks.	
8. Wipe clean and file smooth.	



METHOD OF EVALUATION:

Check pail for water tightness.

JOB SHEET
IDENTIFICATION CODE

JOB: Attach, Light and Adjust Cutting Torch

UNIT III: Welding

JOB NUMBER: J-3-11

COURSE: Metal Fabrication

EQUIPMENT:
Oxy-Acetylene Tanks
Cutting Torch
Hoses
Gages

TOOLS:
Wrenches
Striker

SAFETY PRECAUTIONS:

1. Observe regular welding safety rules.
2. Wear high leather shoes.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Attach flame cutting head to blow pipe assembly.	. SC-3-2 thru SC-3-4, SC-3-6
2. Open tank cylinders.	
3. Adjust hose pressures to manufacturer's specifications.	
4. Open acetylene valve on blow pipe.	
5. Light the torch using the spark lighter.	
6. Open the oxygen valve on the blow pipe.	
7. Slowly open the oxygen valve on the cutting torch until desired flame is established.	

METHOD OF EVALUATION:

The blue tip inner cone flame should move forward from the tip slightly without changing much in color, when the flame is adjusted correctly.

JOB: Cut Square Plate

UNIT III: Welding

COURSE: Metal Fabrication

MATERIAL: ¼" Cold or Hot Rolled Steel

EQUIPMENT: Oxy-Acetylene Burning Unit

TOOLS:
Rule
Soapstone
Striker

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-3-12

SAFETY PRECAUTIONS:

1. Have adequate ventilation.
2. Do not burn near combustible material.
3. Keep flame away from tanks - Use protective gear.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Mark with rule and soapstone a 6" square on ¼" steel plate.	. SC-3-2 thru SC-3-6 . SC-3-11, SC-3-12
2. Place metal to be cut on cutting table.	
3. Light and adjust cutting torch.	
4. Place cutting flame approximately ¼" above metal to be cut. Preheat until metal is ready to meet.	
5. Press oxygen blow lever, as metal is burned away steadily move tip forward.	
6. Maintain steady even motion until cut is complete.	
7. Check cut for freeness of slag and excessive top melting.	
8. Close blow pipe valves.	

METHOD OF EVALUATION:

If you have excessive slag - you have had too much heat or too slow a rate of travel.

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-3-13

JOB: Pierce Round Holes

UNIT III: Welding

COURSE: Metal Fabrication

MATERIAL: ¼" Hot Rolled Steel

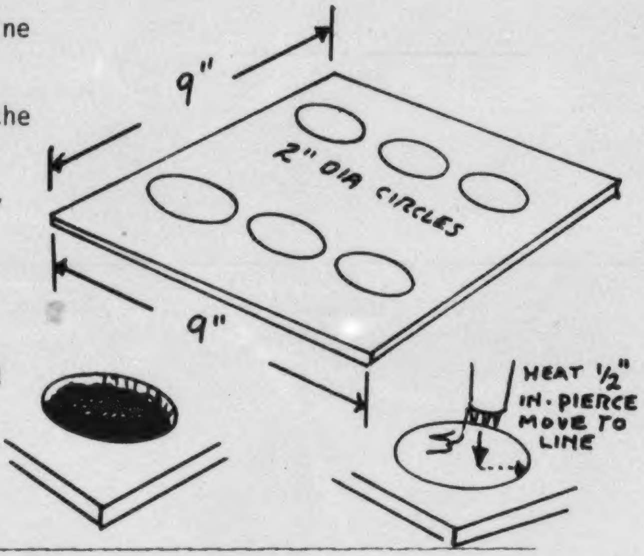
EQUIPMENT: Oxy-Acetylene Cutting Unit

TOOLS: Striker Soapstone
Rule Compass

SAFETY PRECAUTIONS:

1. Wear safety and protective equipment.
2. Have adequate ventilation.
3. Do not burn near tanks of combustible materials.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Locate a piece of ¼" plate 9" square.	. SC-3-2 thru SC-3-6
2. Mark off six 2" diameter holes with soapstone and compass.	. SC-3-13
3. Light and adjust the torch.	
4. Heat an area approximately ½" from line until it is red and ready to melt.	
5. Press the oxygen blow lever. Begin the cut.	
6. Proceed outward to line and carefully cut on soapstone line.	
7. Keep the torch tip, pointed slightly forward into the cut joint.	
8. Check disc and hole for roundness and neatness of cut.	
9. Close blow pipe valves.	



METHOD OF EVALUATION:

Absence of slag and top burn shows you have had the correct heat and rate of travel.

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-3-14

JOB: Radius Bend ½" Round Rod

UNIT III: Welding

COURSE: Metal Fabrication

MATERIAL: ½" Hot Rolled Round Rod (10 inches)

EQUIPMENT: Oxy-Acetylene Welding Unit
Welding Glasses
Vise
Gloves

TOOLS: Hammer
1 Pair of Vise Grips

SAFETY PRECAUTIONS:

Use all oxy-acetylene welding precautions and safety measures.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Place rod in bench vise approximately 3".	. SC-3-2 thru SC-3-6, SC-3-14
2. Light and adjust torch.	
3. Heat the rod 1" each way from the center until it is cherry red, a length of 2".	
4. Close blow pipe valves.	
5. Clamp a pair of vise grips on end not in vise.	
6. Apply pressure and bend until bar is bent 90°.	
7. Quench cold with water.	

METHOD OF EVALUATION:

1. Check for accuracy of bend.
2. Check to be sure rod was not overheated.

JOB: Heat Shrink Stretched Panel

UNIT III: Welding

COURSE: Metal Fabrication

MATERIAL: 24 Gage Cold Rolled Steel (12" X 12")

EQUIPMENT: Welding Torch and Tanks

TOOLS: Pick Hammer / Flat Peening Hammer
Flat Dolly / Water and Sponge

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-3-15

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Place metal on table, with pick hammer put several dents in flat of sheet.	. SC-3-2 thru SC-3-5, SC-3-15
2. Place sheet in upright position in vise.	
3. Light and adjust torch with neutral flame. Heat the dents and immediate area to cherry red.	
4. Place dolly on metal on the opposite side of the dents.	
5. Strike dents with peening hammer until metal is back flat to almost its normal form.	
6. Quench area with wet sponge before area cools.	
7. Close blow pipe valves.	

METHOD OF EVALUATION:

If you have heated, bumped and quenched the metal correctly, no previous dents or stretch marks will show. The heating and bumping will have shrunk the stretched areas back to their original states.

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-3-16

JOB: Arc Weld Stringer Beads

UNIT III: Welding

COURSE: Metal Fabrication

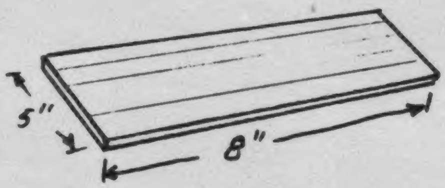
MATERIAL: 3/16" Plate 5" X 8" (1/8" - 6013 Electrode)

EQUIPMENT: Cutting Torch
Grinder
Arc Welder

TOOLS: Slag Hammer
Rule
Soapstone

SAFETY PRECAUTIONS:

1. Handle torch in safe efficient manner.
2. Be sure hoods, glasses and gloves are used.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Cut one piece cold rolled steel 3/16" X 5" X 8".	. SC-3-16
2. Draw four lines on plate 1" apart through the 8" length.	
3. Use 1/8" (6013 electrode).	
4. Set heat settings and current.	
5. Start welding machine.	
6. Hold electrode almost perpendicular to work.	
7. Run bead on line #1 using a steady forward motion (from left to right on piece).	
8. Proceed with same procedure on line #2.	
9. On lines 3 and 4 start from right side of piece and travel to left.	
10. Check beads for uniformity of height, width and penetration of base metal.	
11. Shut off welder.	

METHOD OF EVALUATION:

Check for bead width, height, penetration and uniformity.

JOB: Arc Weld Horizontal Bead

UNIT III: Welding

COURSE: Metal Fabrication

MATERIAL: ¼" Cold Rolled Steel 3" X 8" (2 Pcs)
1/8" E6010 Electrodes

EQUIPMENT: Arc Welder
Iron Worker
Disc Sander

TOOLS: C-Clamps
Slag Hammer

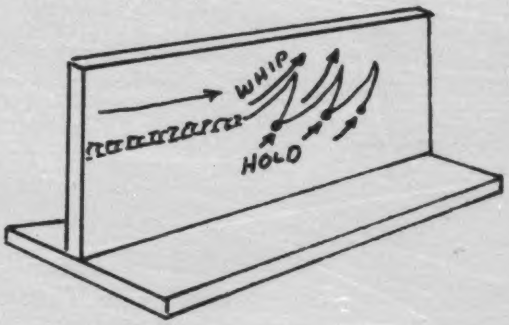
JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-3-17

SAFETY PRECAUTIONS:

1. Protect yourself with proper equipment.
2. Maintain adequate ventilation
3. Keep safety of fellow workers in mind.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Bevel one 8" edge on the two pieces of metal.	. SC-3-16
2. Clamp together with "C" clamps maintaining a 1/16" root opening.	
3. Select proper heat and current settings.	
4. Start the welding unit.	
5. Strike arc on left side of plates and run bead from left to right.	
6. Rod should be 5° below perpendicular and pointed slightly into weld.	
7. Shorten or crowd the arc at the top of the weave.	
8. Reduce current if necessary to maintain good bead shape.	



METHOD OF EVALUATION:

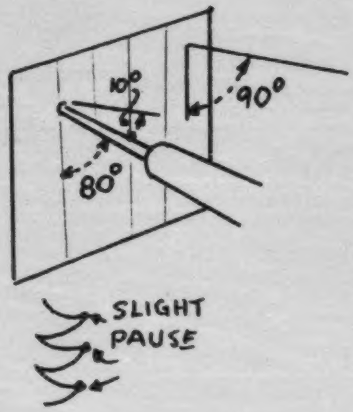
Check bead for width, height, penetration and uniformity.

JOB:	Arc Weld Vertical Bead Down	JOB SHEET IDENTIFICATION CODE
UNIT III:	Welding	JOB NUMBER: J-3-18
COURSE:	Metal Fabrication	
MATERIAL:	¼" Cold Rolled Plate 1/8" E6013 Electrode	
EQUIPMENT:	Arc Welding Unit Iron Worker Grinder	
TOOLS:	Rule Soapstone Slag Hammer	

SAFETY PRECAUTIONS:

Protect eyes, feet, hands and shield weld rays from fellow workers.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Cut plate 6" X 8".	. SC-3-16
2. Mark 4 lines, 6" long on plate.	
3. Set plate in vertical position.	
4. Select proper heat setting and current.	
5. Start the machine.	
6. Begin bead at top of plate on line to left side of plate.	
7. Maintain rod position in an up position about 8^{o} or 10^{o}.	
8. Maintain close arc contact.	
9. Pause slightly at upper end of bead.	
10. Complete beads on all marks.	
11. Check for uniformity of penetration and bead.	



METHOD OF EVALUATION:

Check for width, height, penetration and uniformity of bead.

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-3-19

JOB: Arc Weld a Vertical Bead Up

UNIT III: Welding

COURSE: Metal Fabrication

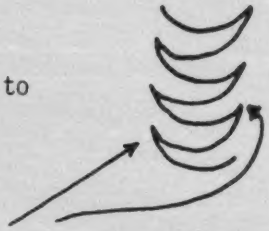
MATERIAL: 3/8" Hot Rolled Plate 6" X 8"
E-6013 Electrode 5/32 Diameter

EQUIPMENT: Cutting Torch
Arc Welder
Grinder

TOOLS: Slag Hammer
Rule
Soapstone

SAFETY PRECAUTIONS:

1. Wear necessary safety equipment.
2. Keep arc flash away from fellow workers.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Place plate in vertical position.	. SC-3-16
2. Mark four lines 1" apart across the 8" side of the plate.	
3. Adjust to proper heat and current settings.	
4. Strike arc at bottom of plate.	
5. Rod position should be perpendicular to work.	
6. Proceed to run bead upward.	
7. Pause slightly at the height of each weave.	
8. Run weave bead all the way to the top of plate.	
9. Run beads on three other lines.	
10. Shut off machine.	

METHOD OF EVALUATION:

Check bead for width, height, penetration and uniformity.

JOB: Arc Weld Overhead Beads

UNIT III: Welding

COURSE: Metal Fabrication

MATERIAL: 1/4" Cold Rolled Plate 6" X 8"
E-6013 Electrodes 1/8" X 12" or 14"

EQUIPMENT: Arc Welder
Cutting Torch
Grinder

TOOLS: Wire Brush
Slag Hammer

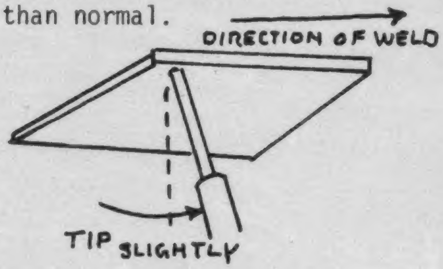
JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-3-20

SAFETY PRECAUTIONS:

Be sure you are well protected with necessary equipment.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Clamp metal in position so overhead welding can be done in comfortable position.	. SC-3-16
2. Adjust to proper heat and current settings.	
3. Turn on machine.	
4. Start bead on piece away from you and weld toward you.	NOTE: Rod should be tipped slightly into weld and arc distance a little closer than normal.
5. Maintain a closer arc distance than normal.	
6. Check for excessive dropping and cut heat a little if necessary.	
7. Run several more beads until uniformity is achieved.	
8. Shut off welder.	



METHOD OF EVALUATION:

1. Check beads, they should be 1/4" to 3/8" wide and 1/8" high at center.
2. Ripples should be fairly uniform.

JOB: Arc Weld a Butt Joint

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-3-21

UNIT III: Welding

COURSE: Metal Fabrication

MATERIAL: 3/16" Hot Rolled Steel

EQUIPMENT: Band Saw
Welder

TOOLS: Slag Hammer
Rule
Soapstone or Scribe

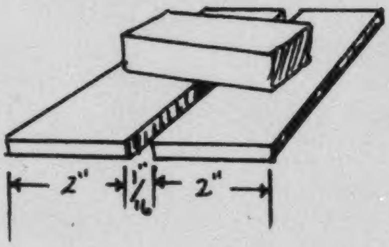
SAFETY PRECAUTIONS:

Be sure you are using all necessary protective and safety equipment.

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

1. Cut 2 pieces of 3/16" X 2" flat stock six inches long.
2. Place them on the welding table so they are 1/16" apart.
3. Place a weight across the center of both pieces so they do not move.
4. Use 1/8" - #6013 coated rod.
5. Set heat setting and current.
6. Tack weld both ends of the joint.
7. Run weld from left to right completely through joint.
8. Check the weld. It should be raised above base metal slightly and of uniform width through entire piece.
9. Check back side for proper penetration.
10. Shut off welder.



NOTE: Rod should be almost perpendicular to work.

METHOD OF EVALUATION:

Place welded job in vise and bend 90° at joint to check for soundness of weld.

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-3-22

JOB: Arc Weld Edge Joints

UNIT III: Welding

COURSE: Metal Fabrication

MATERIAL: 1/8" Hot or Cold Rolled Steel

EQUIPMENT: 4' Power Shears
Press Brake
Welder

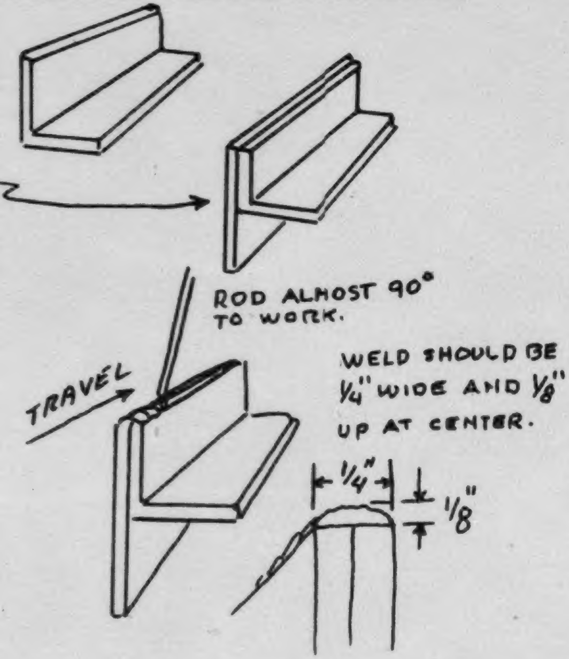
TOOLS: Rule
Scribe
Slag Hammer

SAFETY PRECAUTIONS:

Observe all necessary safety rules when cutting and welding.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

1. Cut 2 pieces of 1/8" plate 3" X 7".
2. Bend one piece 90⁰ so you have 1½" legs.
3. Clamp the two pieces together in this position.
4. Use 3/32" X 12" or 14" - 6013 coated rod.
5. Adjust current settings and heat. Start the machine.
6. Tack weld both ends of the pieces.
7. Run a continuous bead across the top of both pieces.
8. Clean slag and check weld for uniformity of ripples, height, and width across the joint.
9. Shut off welder.



METHOD OF EVALUATION:

Place joint in vise and spread as in J-3-6.

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-3-23

JOB: Arc Weld Corner Joints

UNIT III: Welding

COURSE: Metal Fabrication

MATERIAL: 3/8" Hot Rolled Plate or Flat Stock

EQUIPMENT: Band Saw
Grinder Welder

TOOLS: Slag Hammer
Soapstone or Scratch Awl Rule

SAFETY PRECAUTIONS:

1. Use all necessary fire and burn precautions.
2. Wear all necessary safety equipment.

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

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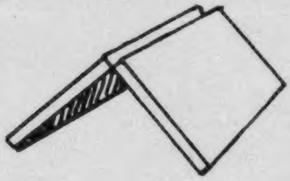
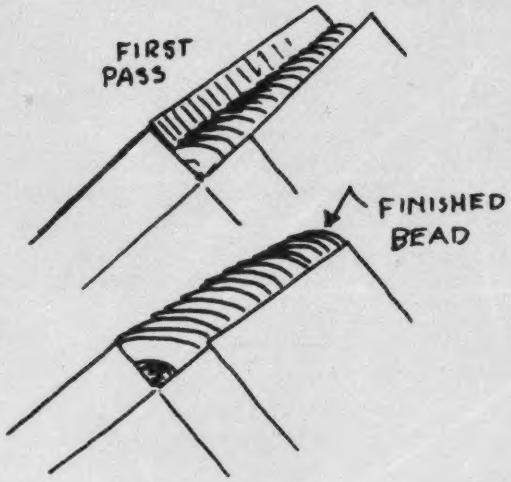
1. Cut 2 pieces of 3/8" X 2" bar stock nine inches long.
2. Position pieces as shown.
3. Use 5/32" X 14" E-6024 or E-7024 electrodes.



4. Adjust heat and current settings according to manufacturer's recommendations. (Turn on the machine)
5. Proceed by making a root pass with little or no weaving motion. (clean)
6. Apply second bead with a weaving motion and rate of travel that will build up a bead having a radius equal to the thickness of the plate.
7. Clean and inspect bead carefully. Note carefully the line of fusion, ripples and contour of finished joint.
8. Shut off welder.



METHOD OF EVALUATION:

Put joint in anvil and flatten against back of weld to check soundness of joint.

JOB: Arc Weld a Tee Joint

UNIT III: Welding

COURSE: Metal Fabrication

MATERIAL: 3/16" Cold Rolled Steel

EQUIPMENT: Cutting Torch
Grinder
Welder

TOOLS: Slag Hammer
Rule
Soapstone

JOB SHEET
IDENTIFICATION CODE

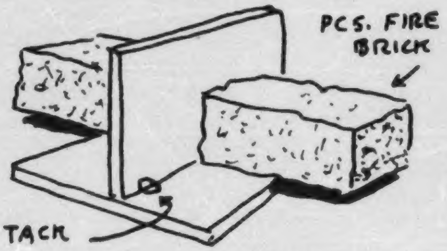
JOB NUMBER: J-2-24

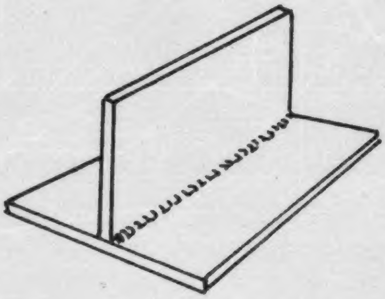
SAFETY PRECAUTIONS:

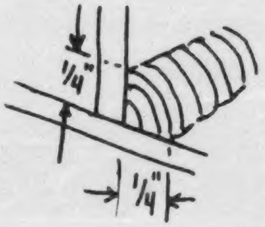
1. Wear all necessary safety equipment.
2. Keep combustible material away from torch and welder.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

1. Cut two pieces of 3/16" plate 3" X 8".
2. Place one flat piece on the table and set the second piece perpendicular to the flat piece.
3. Use clamps or a weight to hold pieces in position.
4. Use 1/8" #6013 coated rod.
5. Set heat settings and current.
6. Tack weld both ends and center to hold pieces in place.
7. Clean and brush all slag from tacks.
8. Keep rod angle at 45° to joint and pointed slightly into the weld.
9. Weld from left to right.
10. Check welds - they should be up ¼" and on the flat ¼" - weave should be uniform.
11. Shut off welder.







METHOD OF EVALUATION:

Place T joint on anvil with weld face down. While holding job with vise grips flatten with hammer to check soundness of weld.

JOB: Arc Weld a Lap Joint

UNIT III: Welding

COURSE: Metal Fabrication

MATERIAL: 3/16" Cold or Hot Rolled Steel

EQUIPMENT: Cutting Torch
Grinder
Arc Welder

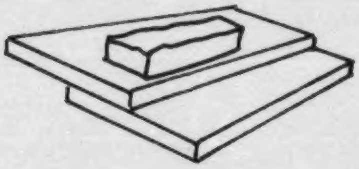
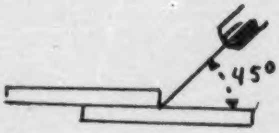
TOOLS: Slag Hammer

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-3-25

SAFETY PRECAUTIONS:

1. Use all safety precautions while burning.
2. Use all safety precautions while grinding.
3. Make sure all protective devices are used for welding.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Cut two pieces of steel 3" X 7".	NOTE: Grind if necessary.
2. Place them on the welding table lapping the top piece on the bottom piece as shown.	
3. Place weights on pieces so they cannot move.	
4. Use 1/8" coated #6013 electrode.	
5. Set heat and current as per manufacturer's recommendation.	
6. Hold rod at approximately 45° to joint.	
7. Place tack welds on both ends of joint.	
8. Remove slag from tacks and brush clean.	
9. Proceed to weld the plate completely through joint. (left to right)	
10. Check weld, it should be approximately 3/16" up and 3/16" on flat. Ripples should be uniform.	
11. Shut off welder.	

METHOD OF EVALUATION:

Place joint in vise with weld joint just above jaws of vise. Hammer against the protruding piece towards the welded side to check soundness of weld joint.

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-3-36

JOB: Arc Weld Pipe (Practice Beads)

UNIT III: Welding

COURSE: Metal Fabrication

MATERIAL: (1) Pc 6" Black Pipe - 1/4" to 3/8" Wall Thickness

EQUIPMENT: Power Saw
Arc Welder-E6010 or E6011 Electrodes (5/32" Diameter)

TOOLS: Pick Hammer
Wire Brush

SAFETY PRECAUTIONS:

Wear gloves, helmet, leather shoes and cape.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Place pipe in a position where it can be welded from all angles.	
2. Adjust welder to proper heat and current settings.	
3. Turn on welding Unit.	
4. Start practice bead on pipe.	
5. Aim electrode at center of pipe at all times.	
6. Proceed with bead until completely around pipe.	
7. Run several more beads around pipe.	
8. Check beads for uniformity of width and height.	
9. Shut off welder.	

METHOD OF EVALUATION:

Beads should be about ½" in width and 1/8" high at highest point.

JOB: Install Window Awning

UNIT IV: Installation and Repair

COURSE: Metal Fabrication

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-4-1

MATERIAL:
Awning
Flashing Strip
Screws
Caulking Compound

EQUIPMENT:
Hand Drill
Ladders and Planking

TOOLS:
Snips
Level
Scribe
Square
Center Punch
Caulking Gun
Screwdriver
Plumb Bob
Hammer
Drill Bit

SAFETY PRECAUTIONS:

Follow all ladder safety, cutting safety and lifting safety rules.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Replace the counter flashing strip above window.	. SC-2-40
2. Center it.	
3. Level the counter flashing strip and mark the screw holes.	. SC-4-14, SC-4-15
4. Drill undersize holes in the building.	
5. Place awning into position. Draw awning into position with screws.	
6. Plumb sides with level and mark side screw holes.	
7. Remove awning and drill side holes.	
8. Replace awning and tighten all mounting screws.	
9. Set counter flashing in position and seal with caulking compound.	

METHOD OF EVALUATION:

Check overall procedure appearance and accuracy of job.

JOB: Make a Wrought Iron Porch Post

UNIT IV: Installation and Repair

COURSE: Metal Fabrication

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-4-2

MATERIAL:
1" Square Tubing
1" X 1/4" Band Iron
3/4" X 1/8" Band Iron
3/4" X 1/4" Band Iron

EQUIPMENT:
Power Saw
Welding Machine
Disc Sander
Oxy-Acetylene Unit

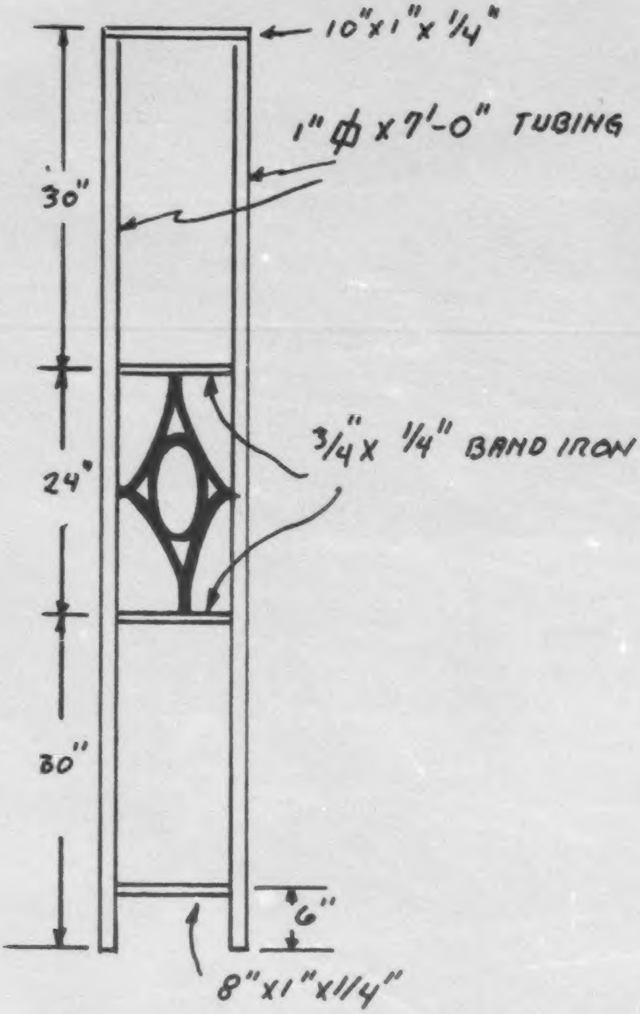
TOOLS:
Draw Clamps
Rule
Hammer
Square

SAFETY PRECAUTIONS:

1. Be sure metal is fastened securely before cutting.
2. Use welding safety procedures at all times.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Cut two pieces of 1" square tubing 7' long.	
2. Cut one piece of 1" X 1/4" band iron 10" long.	
3. Cut one piece of 1" X 1/4" band iron 8" long.	
4. Weld the 10" X 1" X 1/4" piece to the top of the square tubing.	
5. Weld the 8" X 1" X 1/4" piece up 6" from the bottom of the tubing.	
6. Cut two pieces of 3/4" X 1/4" band iron, 30" from top and bottom and weld it to the tubing.	
7. Fabricate diamond and circle of 3/6" X 1/8" band iron. Place it in position in the center opening.	
8. Weld securely.	

9. Clean and dress all welds and prepare them for painting.


10"x1"x 1/4"
1" ϕ x 7'-0" TUBING
30"
3/4"x 1/4" BAND IRON
24"
30"
6"
8"x1"x1/4"

METHOD OF EVALUATION:

1. Check all welds for appearance and soundness.
2. Check overall neatness, appearance and accuracy of post.

JOB: Make a Wrought Iron Railing

JOB SHEET
IDENTIFICATION CODE

UNIT IV: Installation and Repair

JOB NUMBER: J-4-3

COURSE: Metal Fabrication

DRAWING NO: D-4-3 pgs 1 & 2

MATERIAL:
1-1/4" Square Tubing
1-1/4" X 1/8" Band Iron
16 Gage Cold Rolled Steel
1/2" Square Rod
1/8" X 2" Angle
1/2" Square Rod

EQUIPMENT:
Power Saw
Punch
Vise
Electric Welder with Weld Rod
Pipe Wrenches
Drill Press

TOOLS:
Rule
Scribe
Drill Bits

SAFETY PRECAUTION:

1. Wear safety glasses.
2. Keep all welding safety rules.
3. Work in a safe manner.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

1. Measure and cut 1-1/4" X 1/8" band iron for lambs tongue.

2. Draw shape of lambs tongue to full scale and shape metal to pattern.

3. Measure and cut 16 gage black iron for pieces for top and bottom rails.

4. Form rails to proper shape.

5. Punch 1/2" square holes in rails. Holes must be located as to print specifications.

6. Tack weld the two pieces of the bottom rail together. Tack weld the top rail also.

7. Cut 12 pieces of 1/2" square rod 24" long.

8. Place 6 pieces in vise and twist (3 full twists).

9. Measure and cut the pieces of 1/2" square rod needed to fabricate the diamond in the center of the railing.

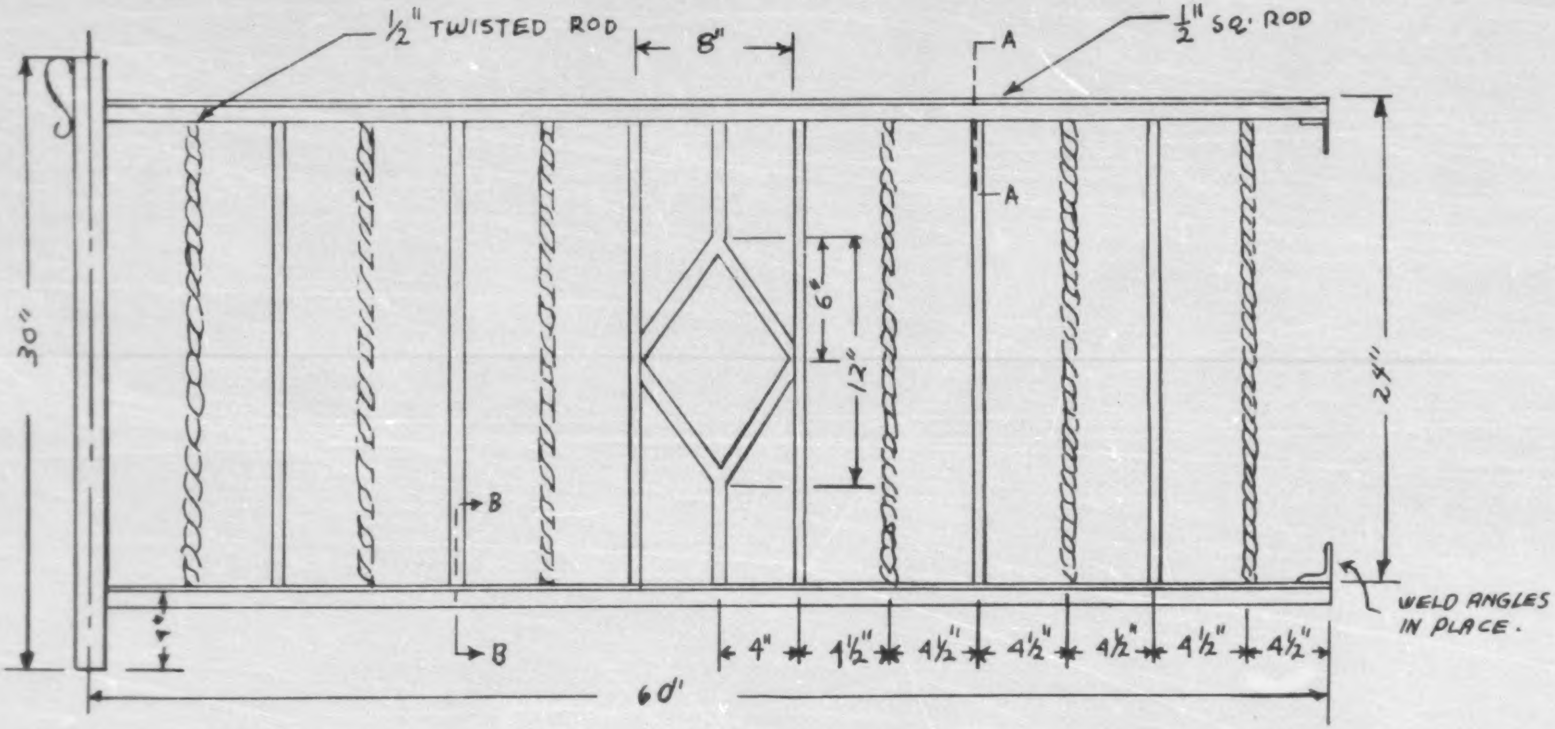
COMPETENCE - PROCEDURE/STEPS

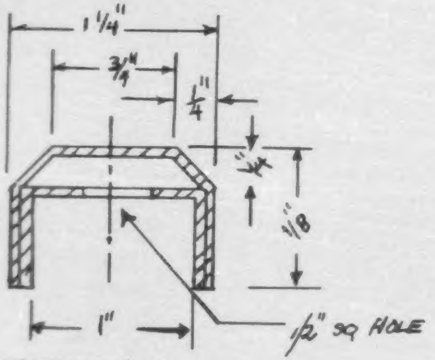
TEACHING/LEARNING ACTIVITIES

10. Weld this diamond unit together.
11. Place all rods into the top and bottom rail holes.
12. Square the unit and weld the rods fast to the rails.
13. Locate the railing on the post and weld it in place.
14. Install lambs tongue and weld it.
15. Install two mounting angles and weld them to the rails as shown on print.
16. File, grind and sand the unit smooth.
17. Prepare the surface for painting.

METHOD OF EVALUATION:

Check overall accuracy, neatness, appearance and procedure of job.


1/2" TWISTED ROD
8"
A
A
1/2" SQ. ROD
30"
6"
12"
24"
B
B
4"
4"
1 1/2"
4 1/2"
4 1/2"
4 1/2"
4 1/2"
4 1/2"
60'
WELD ANGLES IN PLACE.

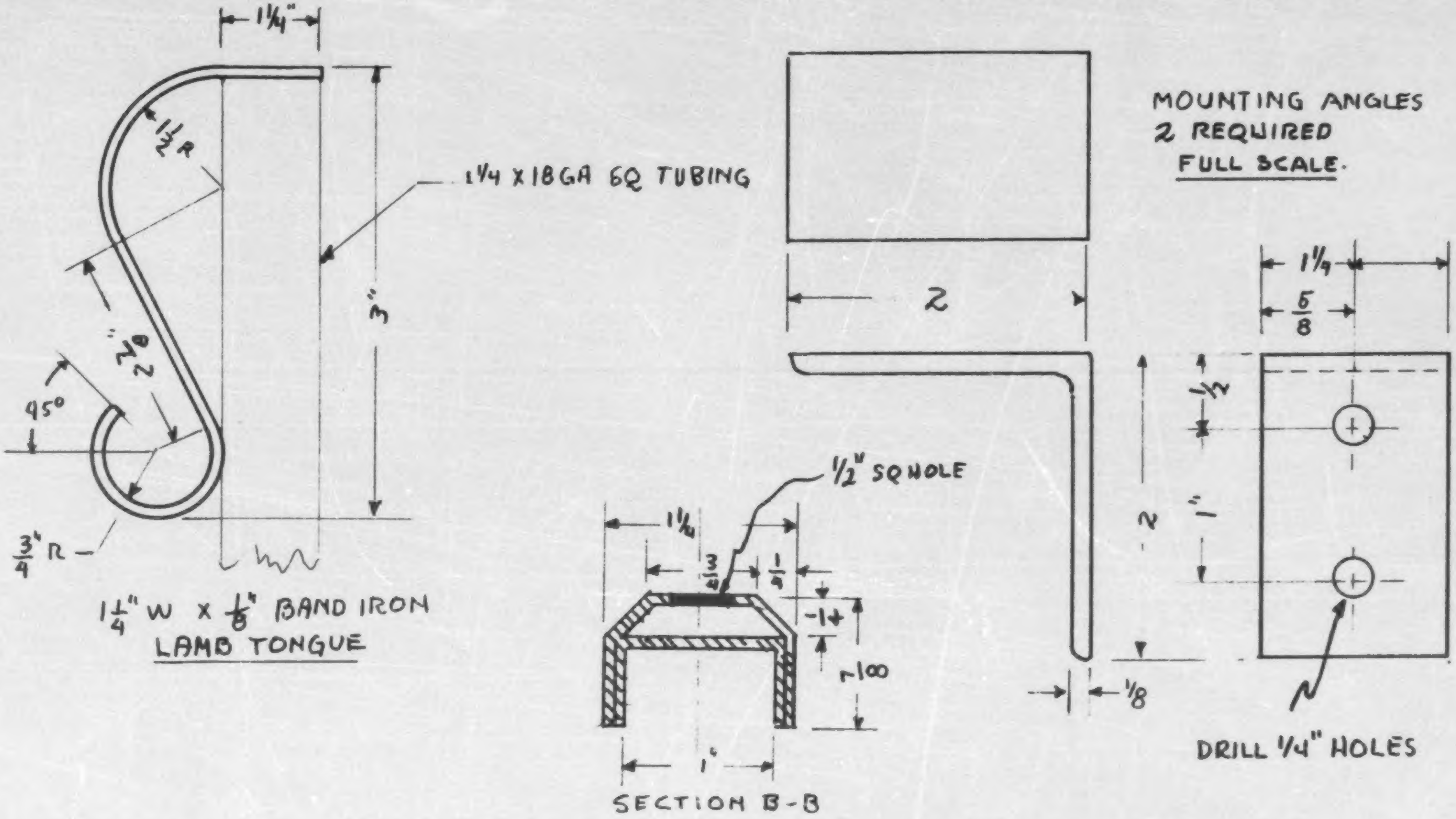

1 1/4"
3/4"
1/4"
1/4"
1 1/8"
1"
1/2" SQ HOLE

SECTION A-A
TOP RAIL MATERIAL FULL SCALE

WROUGHT IRON RAILING

DRAWING NUMBER

D-4-3 pg. 1


1¼"
1½ R
1¼ X 18GA SQ TUBING
3"
2⅛"
45°
¾" R
1¼" W X ⅛" BAND IRON
LAMB TONGUE
1/2" SQ HOLE
1¼
3/4
1/4
1/4
1.00
1"
SECTION B-B
MOUNTING ANGLES
2 REQUIRED
FULL SCALE.
2
1¼
5/8
1/2
1"
2
1/8
DRILL 1/4" HOLES

WROUGHT IRON RAILING

DRAWING NUMBER

D-4-3 pg. 2

JOB: Fabricate Roof Ventilator

UNIT IV: Installation and Repair

COURSE: Metal Fabrication

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-4-4

MATERIAL:	26 Gage Galvanized Metal 3/4" X 1/8" Band Iron	Screws Rivets	Nuts Bolts
EQUIPMENT:	Drawing Equipment Power Shears	Cornice Brake Slip Rolls	Hand Drill
TOOLS:	Rule Scribe	Screwdriver Hand Punch	Snips Hammer

SAFETY PRECAUTIONS:

Practice material handling safety, machine and hand tool safety and personal safety.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

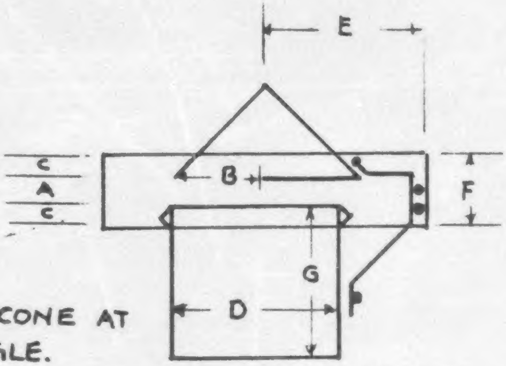
1. Layout profile to full scale using print dimensions.
2. Using profile code, layout all pieces on metal.
3. Cut out and form all pieces.
4. Measure and form band iron brackets.
5. Mark, punch or drill assembly holes in all pieces.
6. Install inner skirt on tube (D).
7. Install brackets to tube (D).
8. Install cone to brackets.
9. Install outside skirt to brackets.

D = 4"

A = DX ·19 E = DX ·90

B = DX ·70 F = DX ·52

C = DX ·15 G = DX 3·



SKIRT & CONE AT 30° ANGLE.

METHOD OF EVALUATION:

Check overall accuracy and appearance of ventilator.

JOB: Install Half Round Gutter

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-4-5

UNIT IV: Installation and Repair

COURSE: Metal Fabrication

MATERIAL: Gutter, Screws, Hangers, Nails, Solder

EQUIPMENT: Soldering Equipment, Tubular Scaffolding, Planking

TOOLS: Hammer, Line Level, Rule

SAFETY PRECAUTIONS:

1. Check all scaffolding connections.
2. Make sure the planking is on scaffolding bars correctly.
3. Make sure the scaffold is steady under all legs.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Locate and install both end hangers.	
2. Stretch a line from the two hangers.	
3. Place line level at an equal distance between the two hangers.	
4. Pitch should be about 1/2 bubble toward drop outlet.	
5. Remove level and install the remaining hangers. Use the line as a guide for setting hanger height.	NOTE: Hangers should be 24" to 30" apart.
6. Place gutter into the hangers.	
7. Solder all gutter joints.	
8. Solder outlet tube to gutter.	
9. Pour water into gutter. It should run toward outlet. (Wipe away excess acid)	
10. Remove scaffolding and clean area.	

METHOD OF EVALUATION:

Gutter must have a straight, uniform appearance, there should be no leaks at the joints.

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-4-6

JOB: Fabricate K or Box Gutter

UNIT IV: Installation and Repair

COURSE: Metal Fabrication

MATERIAL: 28 Gage Galvanized Metal

EQUIPMENT: Shears
Cornice Brake with Mold Attachment

TOOLS: Rule
Scribe
Punch
Hammer

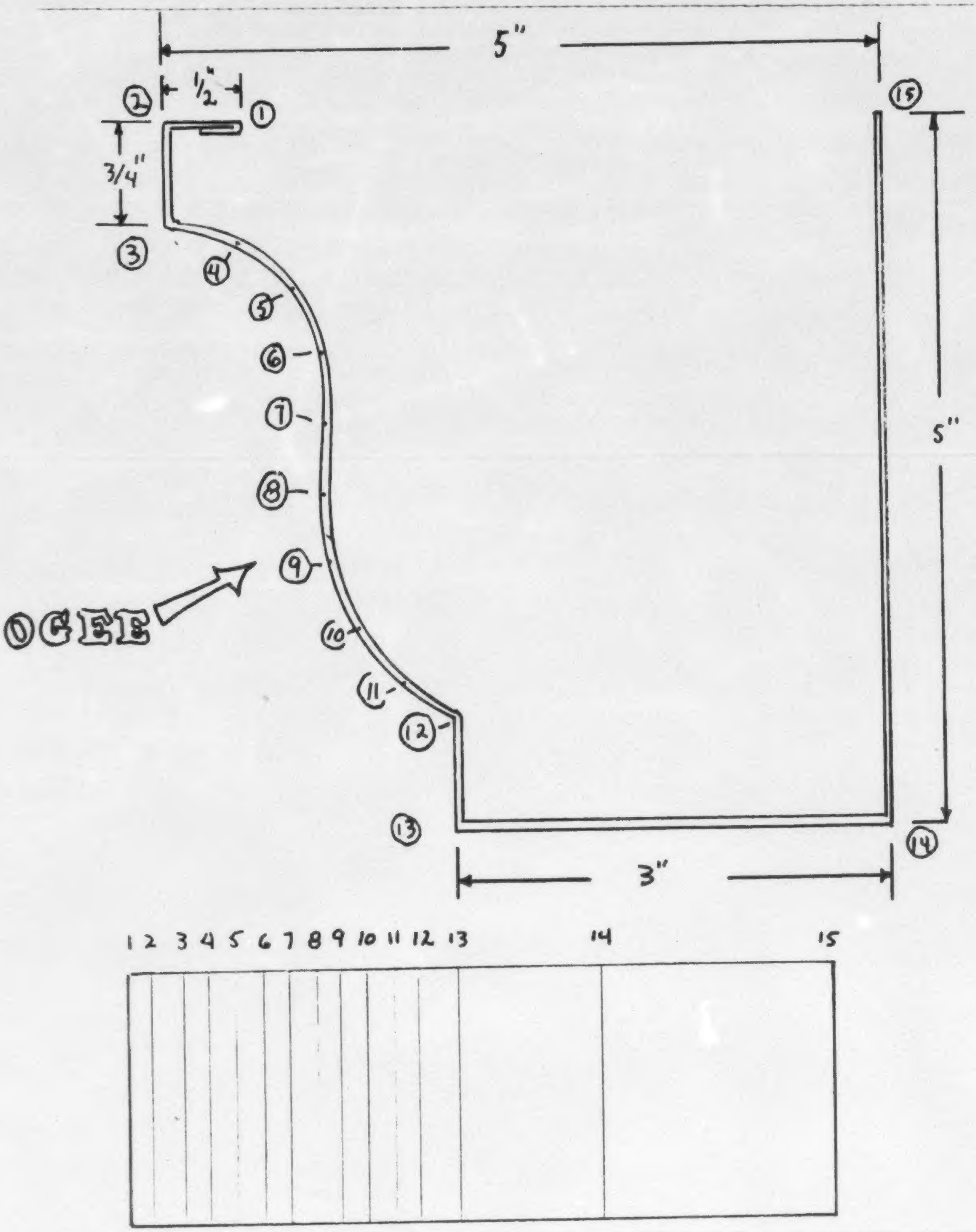
SAFETY PRECAUTIONS:

1. Machine safety.
2. Hand tool safety.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

1. Layout profile for 5" K gutter.
2. Project to get amount of material needed to form gutter.
3. Measure and cut width of material needed.
4. Transfer all bend marks to piece.
5. Prick punch all marks.
6. Bend marks 1, 2 and 3 to profile.
7. Place molding bar in brake and form ogee bends.
8. Bend marks 11, 12 and 13 according to profile.

There is a drawing on the other side


5"
1/2"
3/4"
5"
3"
OGEE
①
②
③
④
⑤
⑥
⑦
⑧
⑨
⑩
⑪
⑫
⑬
⑭
⑮
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

METHOD OF EVALUATION: 171

1. Check height of finished front and back of gutter.
2. Check for uniformity of OGEE bends.

JOB: Make a Range Canopy (Back Straight)

JOB SHEET IDENTIFICATION CODE

UNIT IV: Installation and Repair

JOB NUMBER: J-4-7

COURSE: Metal Fabrication

DRAWING NO: D-4-7

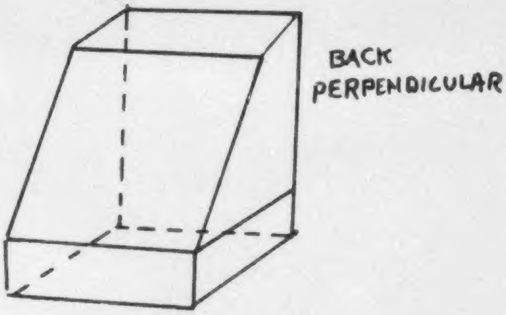
MATERIAL: Paper
Rivets
22 Gage Cold Rolled Steel

EQUIPMENT: Power Shears
Press Brake
Cornice Brake
Hand Punch
Solder with Iron
Stakes

TOOLS: Rule
Snips
Clamps
Solder and Flux
Scribe
Hammer
Rivet Set

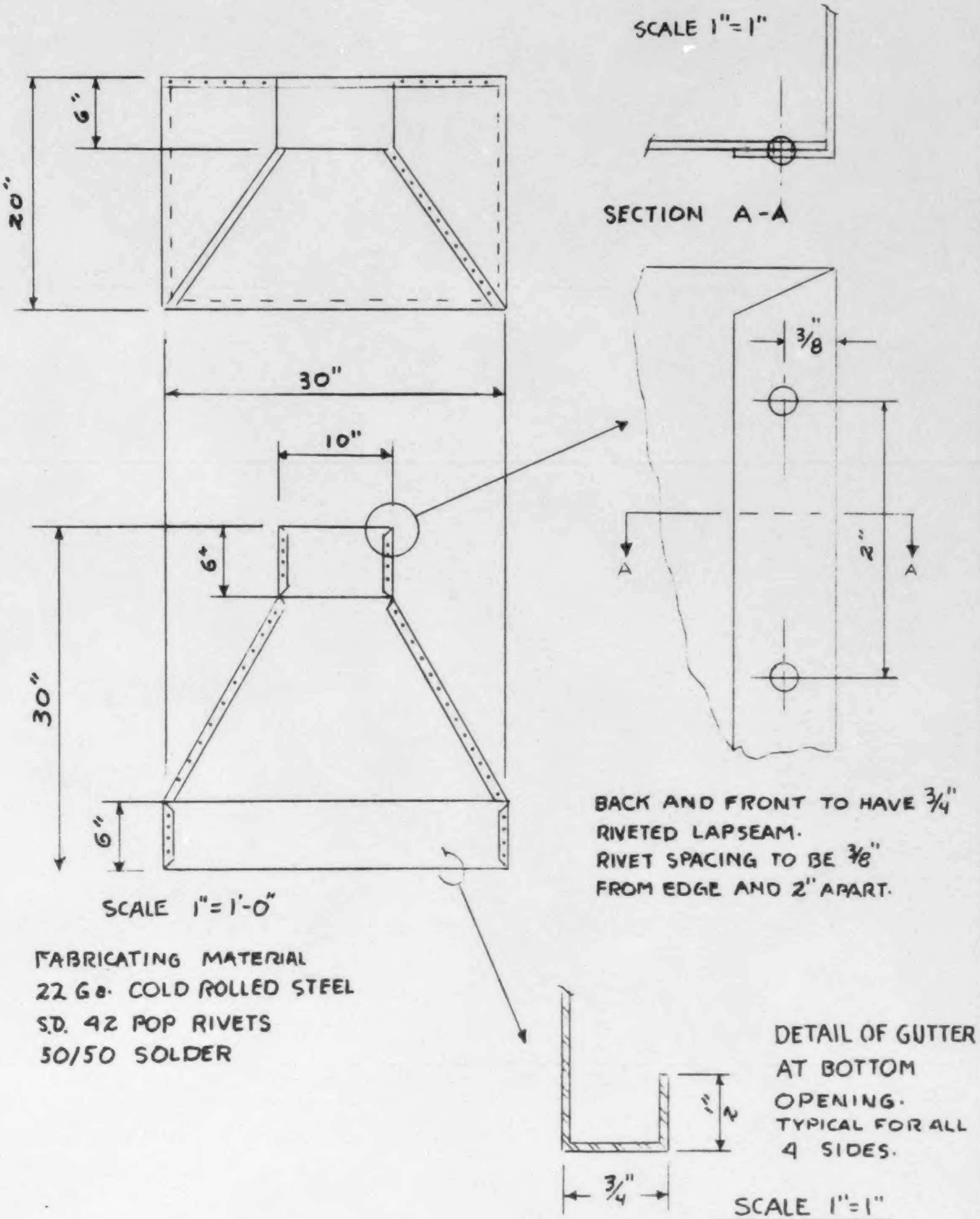
COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

1. Layout exact size of the back piece. Take measurements from blueprint.
2. Layout the two side pieces of the canopy.
3. Obtain necessary measurements from miter lines on side pieces.
4. Use these measurements to obtain pattern for hood front.
5. Scribe lines and prick punch all bends.
6. Cut out all four pieces and notch where necessary.
7. Mark off rivet hole locations (use print for size and location). Punch.
8. Make all necessary bends.
9. Place rivets in holes and upset them.



METHOD OF EVALUATION:

1. Check hood for squareness (it must be square).
2. There should be no hammer marks or dents in the metal.
3. Sizes should finish to within 1/16" of print measurements.


SCALE 1"=1"
SECTION A-A
6"
20"
30"
10"
6"
30"
6"
3/8"
2"
A
A
1"/2
3/4"
SCALE 1"=1"

SCALE 1"=1'-0"

FABRICATING MATERIAL
22 GA. COLD ROLLED STEEL
S.D. 42 POP RIVETS
50/50 SOLDER

BACK AND FRONT TO HAVE 3/4" RIVETED LAPSEAM.
RIVET SPACING TO BE 3/8" FROM EDGE AND 2" APART.

DETAIL OF GUTTER AT BOTTOM OPENING.
TYPICAL FOR ALL 4 SIDES.

RANGE CANOPY (BACK STRAIGHT)

DRAWING NUMBER
D-4-7

JOB: Make a Clothes Rack

UNIT IV: Installation and Repair

COURSE: Metal Fabrication

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-4-8

DRAWING NO: D-4-8

MATERIAL:
- 1" Square Tubing
- 1/2" Round Rod
- 1/16 Cold Rolled Steel
- Wood Plates
- Brazing Rod

EQUIPMENT:
- Band Saw
- Drill Press
- Disc Sander
- Oxy-Acetylene Welding Unit
- 1/4" Nuts and Bolts

TOOLS:
- Rule
- Hammer
- Screwdriver
- Square
- Wrenches
- 45° Angle
- Scribe
- File
- Drill Bits and Countersink
- Emory Paper

SAFETY PRECAUTIONS:

1. Wear safety and welding goggles.
2. Clamp all material securely before cutting.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Mark and cut one piece of tubing 5'-6" long.	
2. Mark and cut one piece of tubing 16" long.	
3. Mark and cut two pieces of tubing 7-1/2" long.	
4. Mark and cut eight pieces of 1/2" rod 5" long.	
5. Mark and cut four pieces of 1" tubing 12" long. Cut all ends at 45°. (Check print.)	
6. Place the 16" piece and the two 7-1/2" pieces together as shown on the print (Section A-A) and braze them together.	
7. Drill 1/4" holes in the base as shown on the print.	
8. Drill eight 1/2" holes at the top end of the 5'-6" post.	
9. Round and sand one end of each 1/2" round rod.	

10. Insert these rods in the holes at a 60° angle.

11. Braze all rods into the tubing.

12. Cut five 1" X 1" X 1/16" plates and fuse them on all five open ends of tubing.

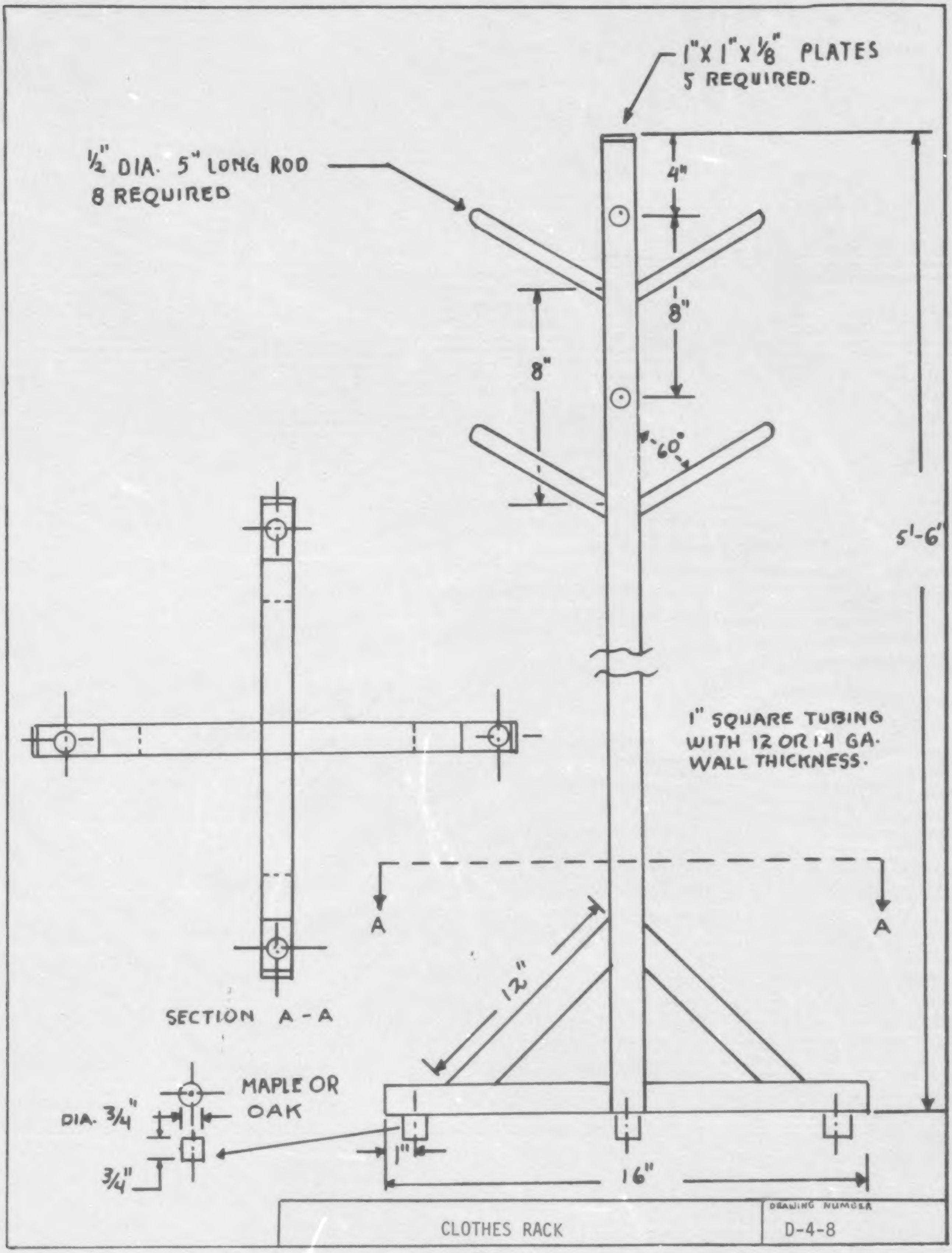
13. Drill and countersink four wood floor plates.

14. Place bolt heads in wood. Bolt up through tubing and install capnuts.

15. File, sand and prepare for painting.

METHOD OF EVALUATION:

Check to be sure completed job stands plumb and all joints are square.


1" X 1" X 1/8" PLATES
5 REQUIRED.
1/2" DIA. 5" LONG ROD
8 REQUIRED
4"
8"
8"
60°
5'-6'
1" SQUARE TUBING
WITH 12 OR 14 GA.
WALL THICKNESS.
A
A
SECTION A - A
12"
MAPLE OR
OAK
DIA. 3/4"
3/4"
1"
16"
CLOTHES RACK
DRAWING NUMBER
D-4-8

JOB: Fabricate and Install Outside Lamp Post

JOB SHEET IDENTIFICATION CODE

UNIT IV: Installation and Repair

JOB NUMBER: J-4-9

COURSE: Metal Fabrication

DRAWING NOs: D-4-9
D-4-9(1)
D-4-9(2)
D-4-9(3)
D-4-9(4)
D-4-9(5)

MATERIAL:
24 Gage Black Iron or Stainless Steel
6' - 2" Black Pipe
Sand and Cement
1/2" Electrical Conduit Pipe
Solder
Rivets
Glass
Water
Standard Light Socket
Screws

EQUIPMENT:
Drawing Equipment
Hand Brake
Shears
Bench Stakes
Bar Folder
Shovel
Pick
Soldering Irons

TOOLS:
Rule
Pencil
Scribe
Square
Screwdriver
Snips
Hammer
Rivet Set
Vise Grips

SAFETY PRECAUTIONS:

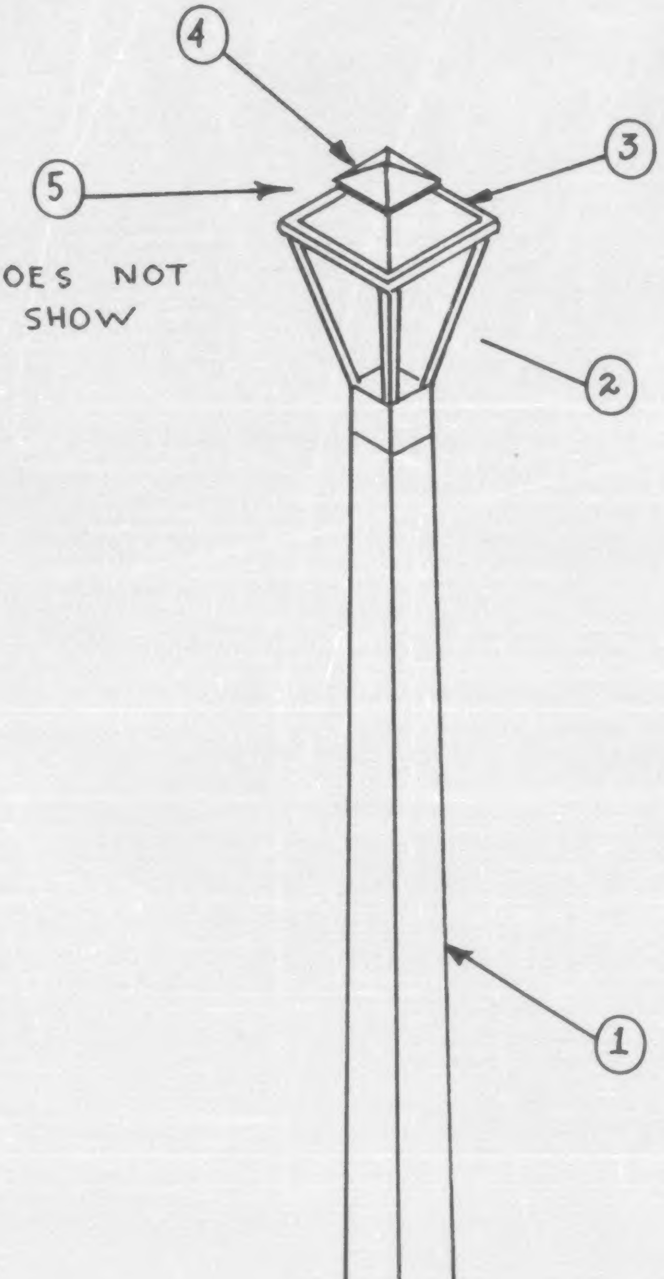
1. Wear safety glasses.
2. Be careful cutting glass (have carpentry shop do this).

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Layout pattern for tapered post.	
2. Layout patterns for lamp assembly.	
3. Transfer post pattern to metal. Mark all cut lines and punch all bend lines. Punch rivet holes.	
4. Bend post in cornice brake and rivet seams. Solder water tight. File and clean.	
5. Fabricate and install bottom flange of post separately.	
6. Place all lamp patterns on metal. Scribe, cut lines, punch, bend lines, and punch rivet screw holes.	

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
7. Cut out and form all pieces.	
8. Assemble the lower portion of the lamp and top covers. Rivet and solder them.	
9. Place hole in lamp bottom. Install light socket.	
10. Measure and cut glass.	
11. Install glass with putty and clips.	
12. Place top caps on glass or base portion of lamp and fasten with self-tapping screws.	
13. With shovel and pick dig a hole 12" in diameter 24" deep.	
14. Place 2" pipe in hole - bottom 8" below ground level. Plumb and secure.	
15. Dig a ditch approximately 4" wide 8" deep. Place 1/2" conduit in ditch. One end of conduit is bent to a 90° angle and inserted up into the 2" pipe 10" to 12".	
16. Feed wire through conduit pipe and up to top of light socket. (Allow for connection to light socket.)	
17. Mix cement to proper proportion and pour hole full (to ground level or 1/2" above).	
18. While cement is still soft, slip lamp base down over 2" pipe and penetrate bottom flange into wet cement.	
19. Remove top cap of lamp and make necessary wire connections to socket.	
20. Replace top.	
21. Do not disturb until cement hardens and unit is firmly in place.	

METHOD OF EVALUATION:

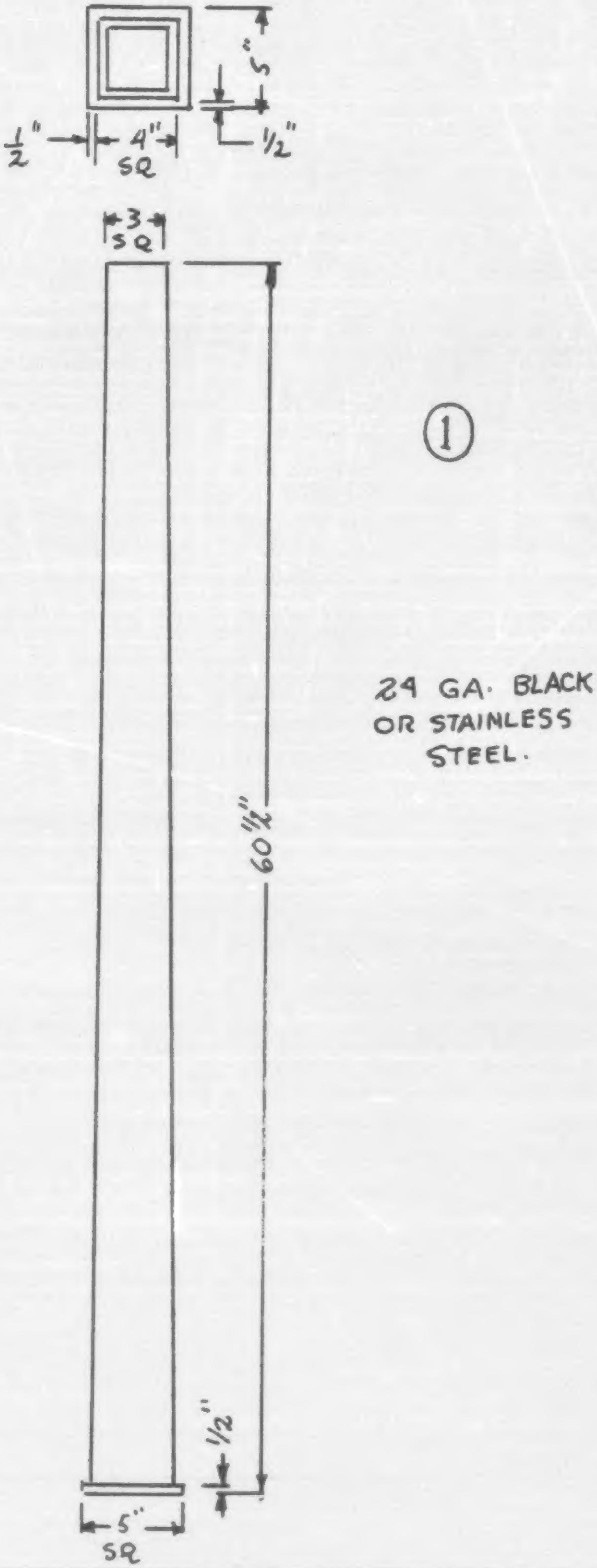
Check overall accuracy and appearance of finished job.


4
3
5
DOES NOT SHOW
2
1

OUTSIDE LAMP POST

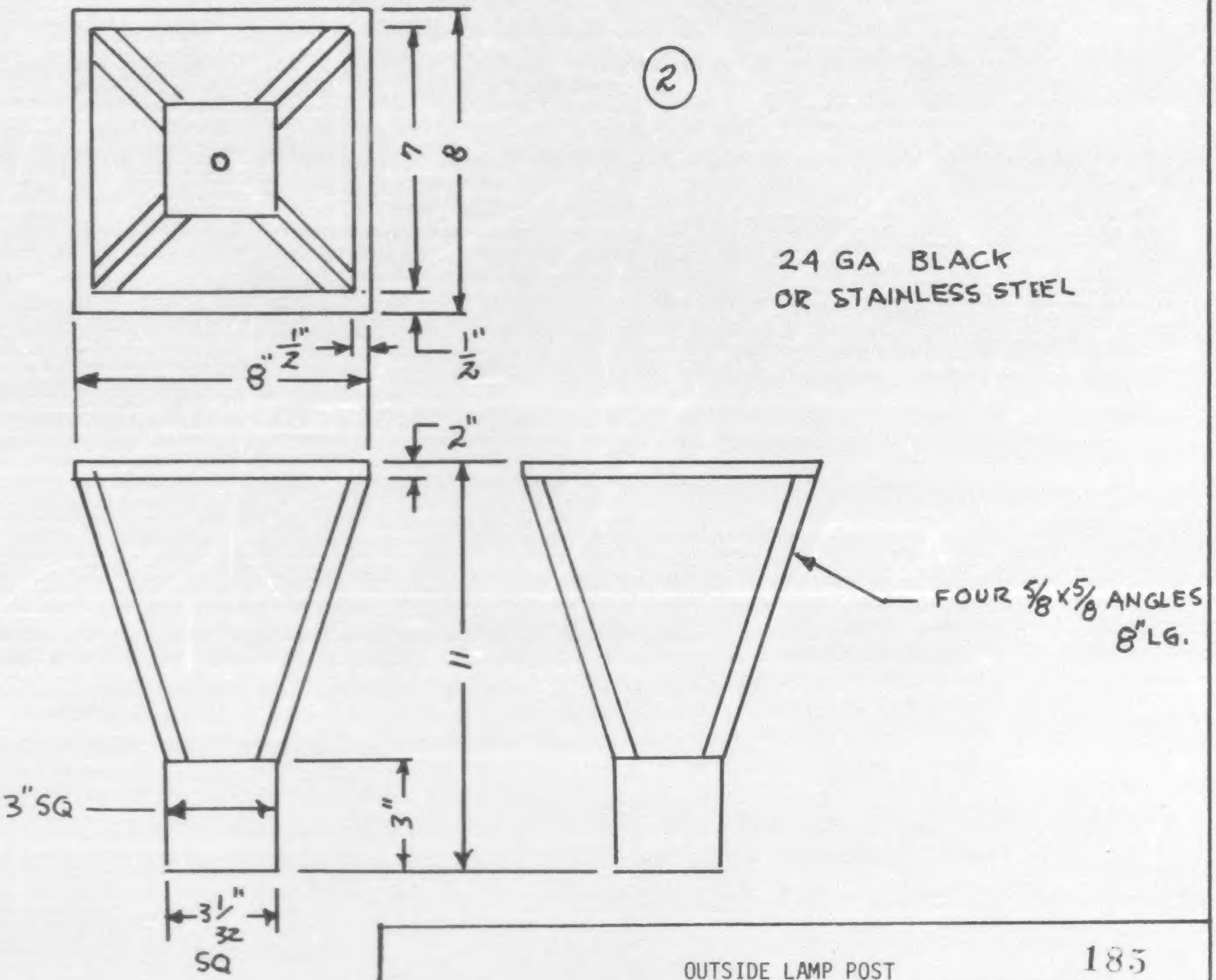
DRAWING NUMBER

D-4-9


5"
1/2"
1/2"
4"
SQ
3
SQ
①
24 GA. BLACK OR STAINLESS STEEL.
60 1/2"
1/2"
5"
SQ

OUTSIDE LAMP POST

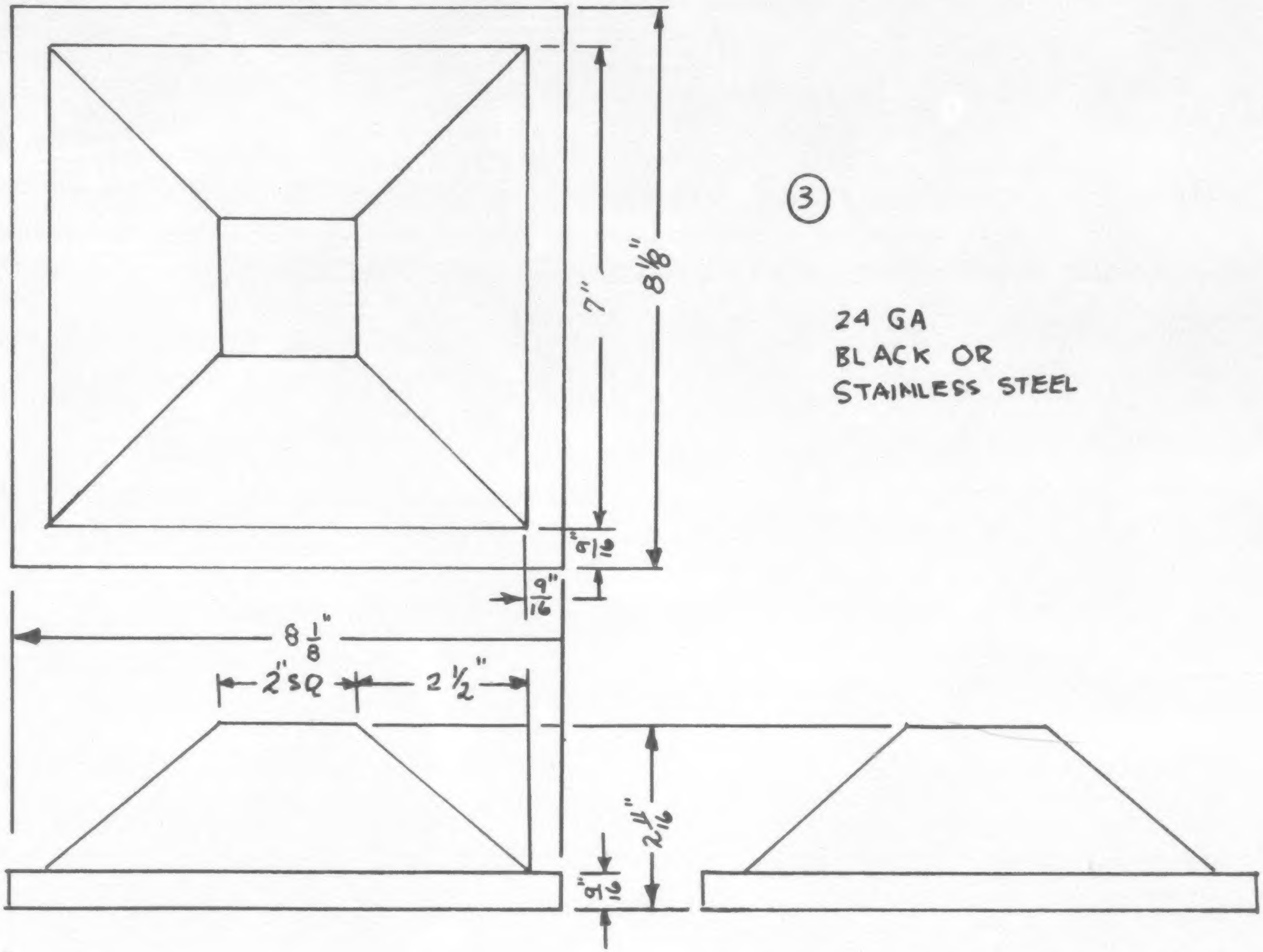
DRAWING NUMBER
D-4-9 (1)


②
7
8
1/2"
1/2"
8"
2"
11
3"
3" SQ
3 1/32" SQ
24 GA BLACK
OR STAINLESS STEEL
FOUR 5/8 x 5/8 ANGLES
8" LG.

OUTSIDE LAMP POST

DRAWING NUMBER

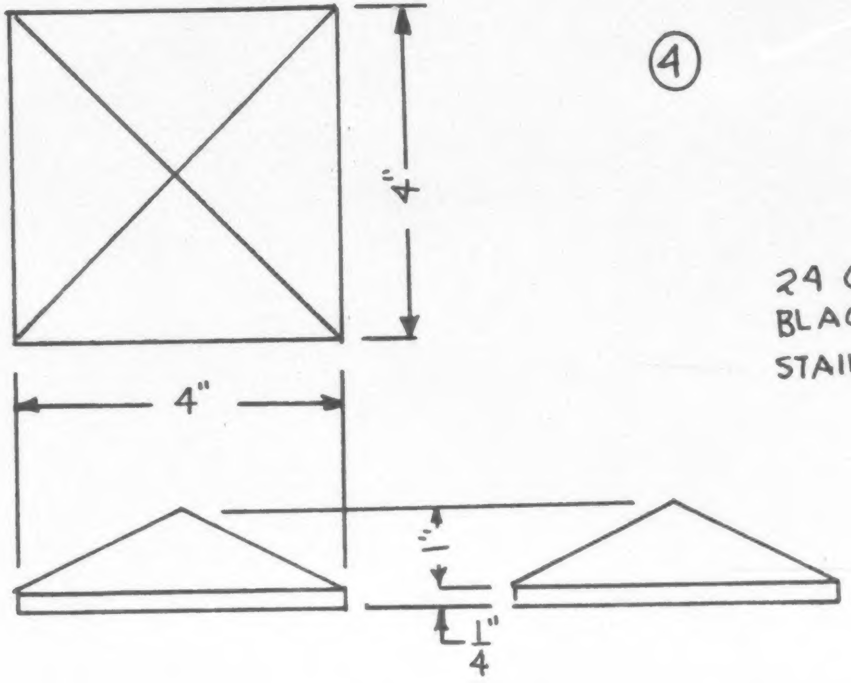
D-4-9 (2)


③
7"
8 1/8"
9/16"
9/16"
8 1/8
2" SQ
2 1/2"
2 11/16"
9/16"

24 GA
BLACK OR
STAINLESS STEEL

OUTSIDE LAMP POST

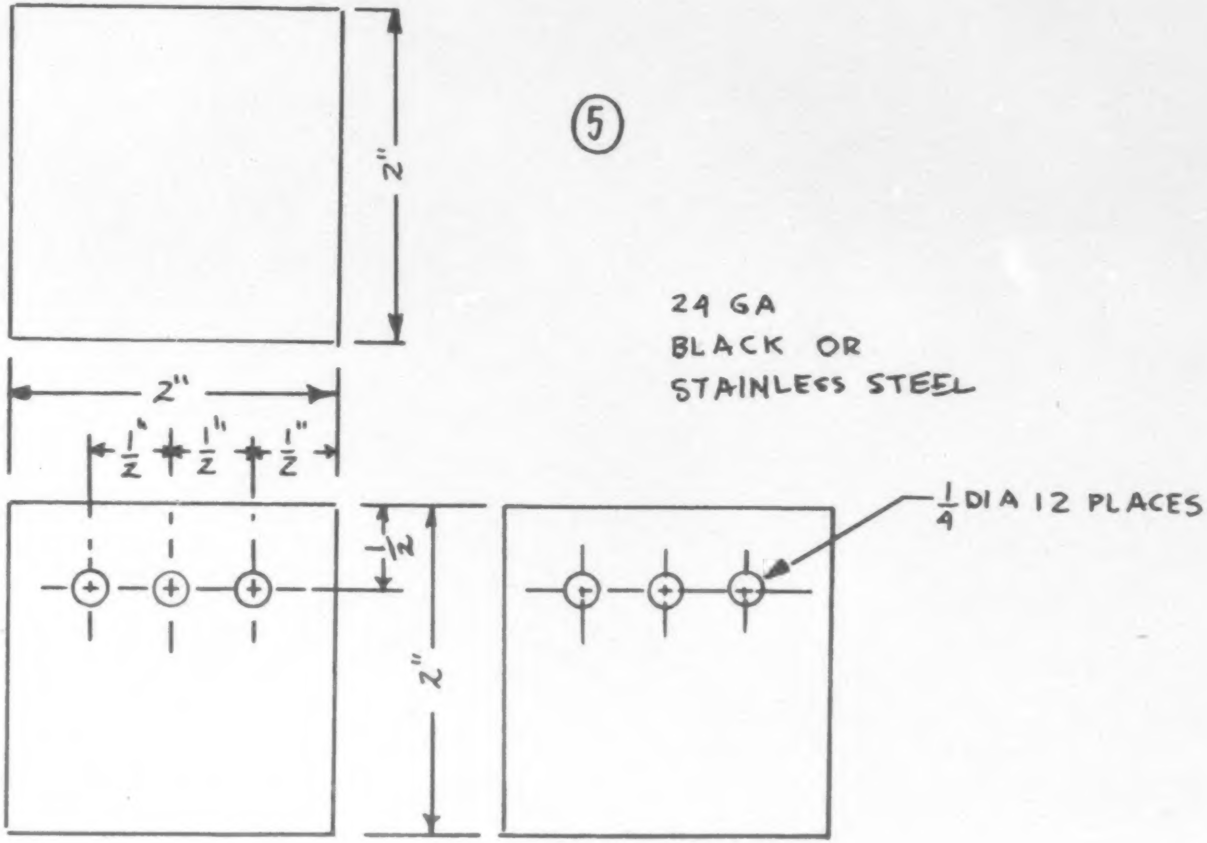
DRAWING NUMBER
D-4-9 (3)



24 GA
BLACK OR
STAINLESS STEEL

OUTSIDE LAMP POST

DRAWING NUMBER
D-4-9 (4)



⑤
2"
2"
1/2"
1/2"
1/2"
1/2
2"
1/4 DIA 12 PLACES
24 GA
BLACK OR
STAINLESS STEEL

OUTSIDE LAMP POST

DRAWING NUMBER

D-4-9 (5)

JOB: Install Wrought Iron Railing

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-4-10

UNIT IV: Installation and Repair

COURSE: Metal Fabrication

MATERIAL:
- Prefabricated Railing
- Lead Shields
- Wood Screws
- Bolts
- Lead

EQUIPMENT:
- Hammer Drill
- Electric Drill
- Masonry Bits
- Firepot

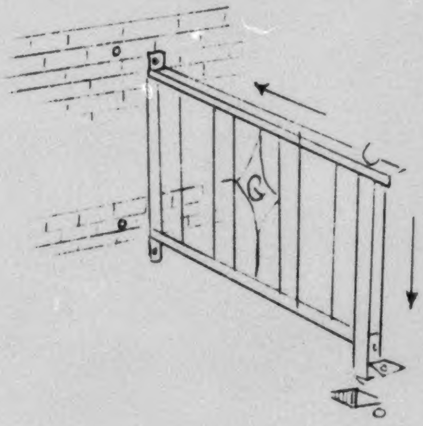
TOOLS:
- Rule
- Hammer
- Level
- Wrenches
- Screwdriver
- Pencil

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

---

1. Place railing at location it is to be fastened.
2. Square it with the building (90°).
3. Use level to plumb railing.
4. Mark a tube location on cement. Mark bracket holes that are to be drilled and plugged.
5. Use hammer drill with masonry bit to drill a series of holes approximately the size of the 1-1/4" tubing.
6. Use flat masonry chisel to square and clean the hole.
7. Drill small pilot holes in concrete and brick building.
8. Place masonry bit in slow speed electric drill and drill holes slightly deeper than length of lead shields. Diameter of bit is the same as shield diameter.
9. Place shields into holes and secure with shield spreader.



COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
10. Reset railing in position and turn all bolts into place.	
11. Heat firepot. Place lead into ladle. Heat and melt lead.	
12. Pour the lead into the hole that is accomodating the post.	CAUTION: Make sure there is no dirt or moisture in the hole opening. (Wear gloves and a face mask.)

METHOD OF EVALUATION:

Recheck railing. It should be plumb and perpendicular to the building.

JOB: Remove and Replace Broken Conductor Elbow

JOB SHEET IDENTIFICATION CODE

UNIT IV: Installation and Repair

JOB NUMBER: J-4-11

COURSE: Metal Fabrication

MATERIAL: Elbow
Solder
Flux

EQUIPMENT: Ladders and Jacks
Prestolite torch
Electric Hand Drill

TOOLS: Hammer
Screwdriver

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Disconnect and remove conductor assembly from building.	
2. Cut damaged elbow in half with hacksaw.	
3. Sweat elbow halves from conductor pipe.	
4. Clean and retin dirty conductor pipe.	
5. Place new elbow on conductor pipe.	
6. Solder water tight.	
7. Reinstall to gutter and building.	

METHOD OF EVALUATION:

Check overall appearance of finished job.

JOB: Install Metal Liner in Wood Flower Box

JOB SHEET
IDENTIFICATION CODE

UNIT IV: Installation and Repair

Job Number: J-4-12

COURSE: Metal Fabrication

MATERIAL:
- 24 Gage Galvanized
- Screws
- Nails
- Solder
- Flux
- 1/2" Copper Tubing

EQUIPMENT:
- Shears
- Brake
- Soldering Iron

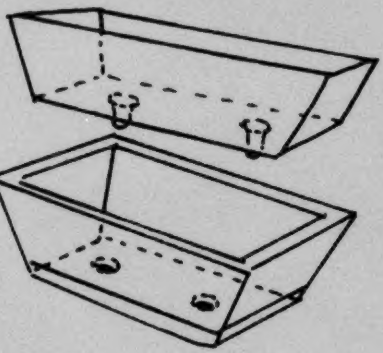
TOOLS:
- Snips
- Hammer
- Drill
- Rule
- File
- Flaring Tool

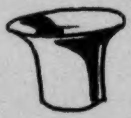
SAFETY PRECAUTIONS:

Be careful of sharp edges and corners.
Wear glasses.

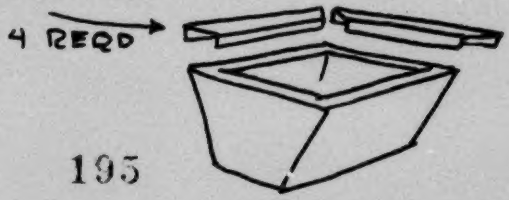
COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

1. Measure inside of wood box.
2. Fabricate metal liner 1/4" smaller in length and width of wooden box.
3. Height should be 1/8" less than box height.
4. Solder liner water tight.
5. Insert metal into box.
6. Drill two 5/8" diameter holes through metal and wood in the bottom of the box.
7. Flange the two pieces of tubing.
8. Insert them into the holes and solder.
9. Fabricate cap strips and install them.





NOTE: Flange must be flush with bottom.

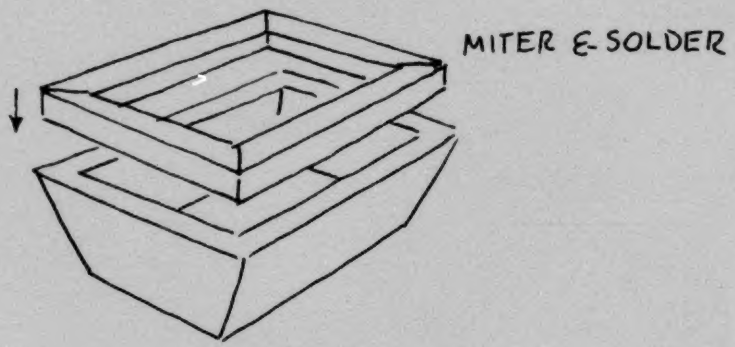


COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

10. Miter the corners and solder them.

11. File all edges smooth.



METHOD OF EVALUATION:

Check overall accuracy, fit and appearance of liner.

JOB: Fabricate and Install a Plenum Chamber

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-4-13

UNIT IV: Installation and Repair

COURSE: Metal Fabrication

MATERIAL: Metal Screws
24 Gage Galvanized Metal

EQUIPMENT: Electric Drill
Shears
Brake
Pittsburgh Lock Former

TOOLS: Rule
Drill Bits
Scribe
1/8" Drill Bit
Prick Punch
Level
Snips

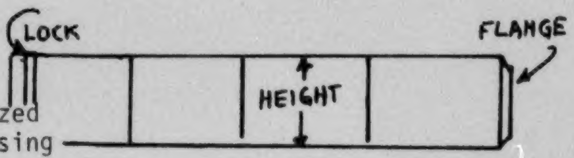
SAFETY PRECAUTIONS:

1. Make sure power equipment is grounded.
2. Protect your eyes, keep your safety glasses on.

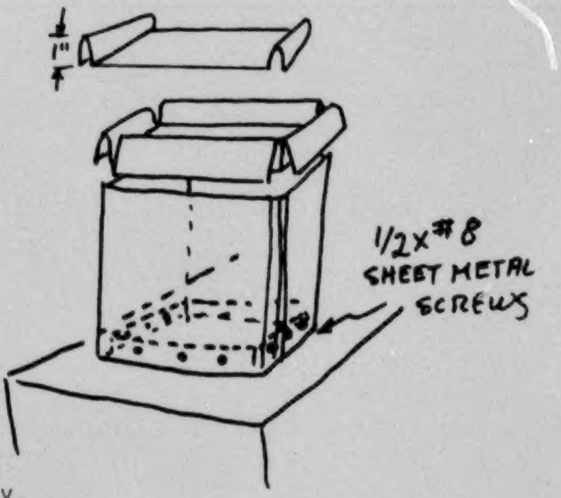
COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

1. Measure opening on air supply unit. Measure allowable height of plenum.
2. Lay out plenum measurements on galvanized metal. Complete joint on one corner using the pittsburgh lock.



3. Plenum top. (Allow for a 1" recess).
4. Cut out and form designated parts of chamber.
5. Install top cap to body.
6. Drill and insert 2 metal screws in each side.
7. Place bottom opening of plenum over upright flange on supply unit.
8. Drill through bottom of plenum and unit flange.
9. Insert screw (1/2" #8) and tighten securely.



METHOD OF EVALUATION:

Turn on unit fan. There should not be any metal vibration and no air loss at the joints.

JOB: Install Prefabricated Square Duct

JOB SHEET IDENTIFICATION CODE

UNIT IV: Installation and Repair

JOB NUMBER: J-4-14

COURSE: Metal Fabrication

MATERIAL:
16 Gage Band Iron
Duct
Screws
Nuts and Bolts
Nails

EQUIPMENT:
Hand Punch
Electric Drill
Scaffolding
Porta Hoist

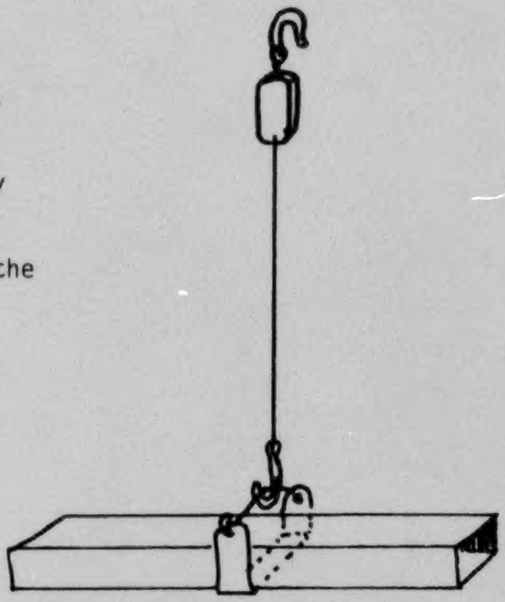
TOOLS:
Rule
Snips
Line Level
Scribe
Hammer

SAFETY PRECAUTIONS:

1. Fasten load securely.
2. Do not at any time stand under lifted material.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

1. Locate and measure exact position duct is to be placed.
2. Erect scaffolding.
3. Install hangers in their proper position.
4. Assemble duct sections on floor (each completed length to measure approximately 15 feet).
5. Securely attach hoisting bars. (Center the bars through duct length).
6. Attach cable to hoisting bar.
7. Directly above center of duct assemble hoisting pulley.
8. Set porta hoist in position and run cables through pulleys and down to cable on hoisting bars.



COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
9. Raise duct into position and lock into place with the hangers that have been previously placed in position.	
10. Repeat these operations until complete run of duct is assembled and in place.	NOTE: The specifications wil determine the type connections used, and the type screws or bolts necessary to make these connections.

METHOD OF EVALUATION:

1. Duct run must be straight, joints neat and air tight.
2. Hangers must appear as an integral part of the job.

JOB: Install Chimney Flashing

UNIT IV: Installation and Repair

COURSE: Metal Fabrication

MATERIAL: Flashing
Counter Flashing

EQUIPMENT: Skill Saw with Carborundum Blade
Ladders
Ladder Jacks

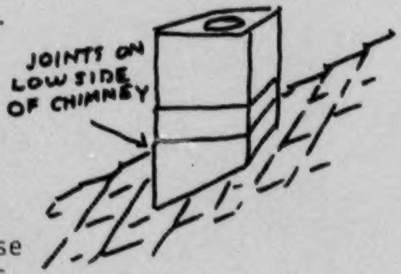
TOOLS: Rule
Hammer
Cape Chisel
Caulking Gun with Caulking

JOB SHEETS IDENTIFICATION CODE

JOB NUMBER: J-4-15

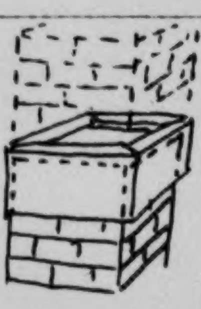
SAFETY PRECAUTIONS:

1. Be sure ladders are safe and secure and planking is held properly.
2. Use face mask and goggles when cutting into mortar.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Place ladders and planking in position. Secure ladders and planks.	
2. Locate mortar joint that must be cut.	
3. Set skill saw guide to depth of 1/2 to 3/4" from edge of carborundum blade.	
4. Make cuts around 4 sides of chimney, use cape chisel and hammer to complete cuts.	
5. Install flashing. Seal watertight.	NOTE: All joints should be on low side of chimney.
6. Cut joint for counter flashing.	
7. Install counter flashing and seal with caulking compound.	NOTE: Counter flashing should be down over flashing 2" to 3".

METHOD OF EVALUATION:

1. Check seal of all joints.
2. Check overall neatness and fit of finished flashing.



JOB: Install Heavy Gage Furnace Breeching

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-4-16

UNIT IV: Installation and Repair

COURSE: Metal Fabrication

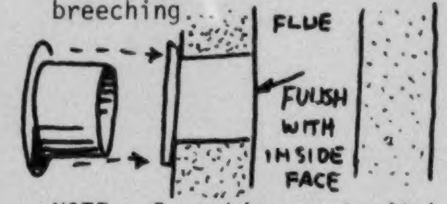
MATERIAL:
16 Gage Black Iron Breeching
3/8" Rod
1" X 1" X 1/8" Angle Iron
Cement
Sand

EQUIPMENT:
Welder
Screws
Hangers
Porta Hoist
Unishear (Heavy Duty)
Asbestos
Power Drill
Nuts
Bolts

TOOLS:
Rule
Level
Drill Bits
Hammer

SAFETY PRECAUTIONS:

1. Use welding safety precautions.
2. Follow hoisting and personal safety rules.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Place thimble in chimney hole and cement into place.	NOTE: Flue thimble is 1/2" to 1" larger in diameter than breeching.
2. Place one short length of pipe into thimble, connecting collar on end of pipe away from flue.	
3. Locate and place necessary hangers.	
4. Assemble the complete breaching on the floor.	NOTE: Breeching must pitch up from furnace to flue opening.
5. Weld all joints to print specifications.	
6. Check furnace damper assembly (it must be operative.	
7. Place hoisting straps around pipe.	
8. Set up hoisting equipment (porta hoist) in proper location.	
9. Connect hoist cable hook to pipe and lift into position.	NOTE: If scaffolding is needed erect and slide into position.
10. Connect one end of breeching to boiler outlet and secure with self threading screws.	

11. Connect pipe you have previously placed into flue thimble to breeching.
12. Secure with self tapping screws.
13. Cover complete breeching with asbestos cover.
14. Adjust hangers, so they are taking the weight of the breeching.
15. Remove hoist, and scaffolding.

METHOD OF EVALUATION:

Check overall appearance, accuracy and procedure of job.

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-4-17

JOB: Replace Worn Bottom of a Copper Pan

UNIT IV: Installation and Repair

COURSE: Metal Fabrication

MATERIAL:
16 Ounce Copper
Emery Paper
Solder
Flux

EQUIPMENT:
Burring Machine
Bench Stakes
Soldering Irons

TOOLS:
Setting Hammer
Dividers
Rule
Scraper
Square
Scribe
Snips
Wire Brush

SAFETY PRECAUTIONS:

1. Avoid breathing dust when sanding old copper.
2. Avoid breathing fumes when soldering.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Use torch to melt old solder from bottom and body.	
2. Use sharp edge of setting hammer to open joint from bottom and pan body.	
3. Straighten body edge on stake.	
4. Set on flat surface.	
5. Set dividers and scribe a line completely around body, trim with snips.	
6. Sand and clean this new edge until bright copper shows up 1/2" from bottom.	
7. Burr a 1/4" edge on body.	
8. Lay out and cut new bottom piece.	
9. Burr 3/16" edge all around bottom.	
10. Square edge with setting hammer and stakes.	
11. Place bottom on body.	

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
12. Double seam bottom to body of pan.	
13. Flux and solder water tight.	

METHOD OF EVALUATION:

Check for water tightness and appearance.

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-4-18

JOB: Reweld Cracked Tank

UNIT IV: Installation and Repair

COURSE: Metal Fabrication

MATERIAL: E-6011 Electrodes

EQUIPMENT: Portable Grinder
Arc Welder

TOOLS: Pick Hammer
Wire Brush

SAFETY PRECAUTIONS:

1. Wear mask and safety glass while grinding.
2. Use all necessary protective equipment while welding.

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

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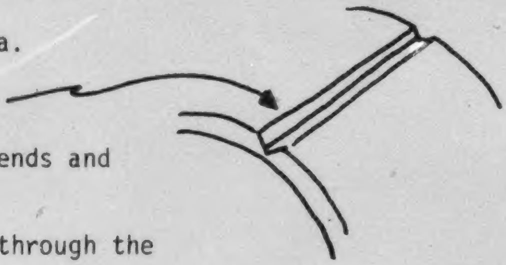
1. Place tank in a good workable position.
2. Grind the entire cracked area.
3. Grind break into a V shape.
4. Tack weld the crack at both ends and several places in between.
5. Run a light bead completely through the break.
6. Clean and brush all slag off weld.
7. Run a weave bead over the top of base weld.
8. Clean and check weld.



METHOD OF EVALUATION:

1. Check preparation of job before welding begins.
2. Check weld for soundness by checking penetration and appearance of finished job.

JOB: Repair Rusted Gutter Outlet

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-4-19

UNIT IV: Installation and Repair

COURSE: Metal Fabrication

MATERIAL: New Gutter Drop
Solder
Flux

EQUIPMENT: Prestolite Torch

TOOLS: Soldering Iron

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Erect ladder and ladder jacks along building having a spout with a rusted eve pipe outlet.	
2. Remove clips from shark and circle hangers and remove gutter carrying to ground.	
3. Use prestolite torch to heat soldered slip joint and remove rusted section.	
4. Install new section with new eve pipe outlet.	
5. Solder new piece in place.	
6. Take gutter up and lay in hangers.	
7. Replace clips on hangers.	

METHOD OF EVALUATION:

Gutter should be straight and water tight.

OPERATION SHEET
SC-1-1

COMPETENCY: Placing Paper on Drawing Board

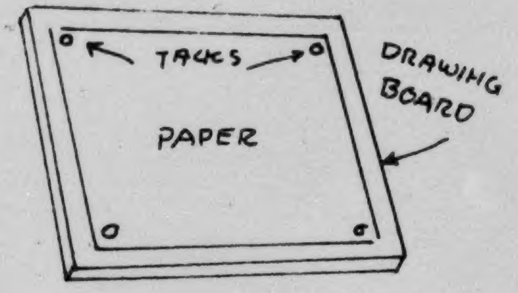
COURSE: Metal Fabrication

UNIT I: Pattern Drafting and Layout

OBJECTIVE: Efficient and proper placement of paper on the drawing board

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Cut paper one-half inch smaller in length and width of the drawing board. 2. Place it evenly on the board. 3. Use thumb tacks or tape to hold the four corners down. 4. Do not let the drawing sheet wrinkle or crease.	NOTE: Learning the methods used in sheet metal pattern work is basic to the beginner. The ability to draw and sketch is important to the Metal Fabricator.



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OPERATION SHEET
SC-1-2

COMPETENCY: Positioning and Moving a T-Square

COURSE: Metal Fabrication

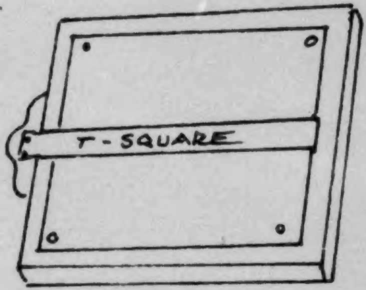
UNIT I: Pattern Drafting and Layout

OBJECTIVE: To properly place and move a T-square

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

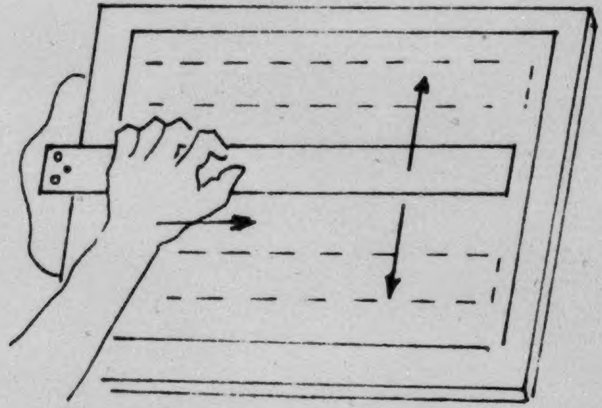
1. Place T-square on the drawing board. The T portion will lockover the left side of the board.



2. Place left hand on the leg of the T-square and pull slightly to the right.

3. Slide T-square up and down the board with the left hand while pulling to the right.

NOTE: This will cause the T-square to be square with the edges of the board at all times.



OPERATION SHEET
SC-1-3

COMPETENCY: Using the 1" Scale Rule

COURSE: Metal Fabrication

UNIT I: Pattern Drafting and Layout

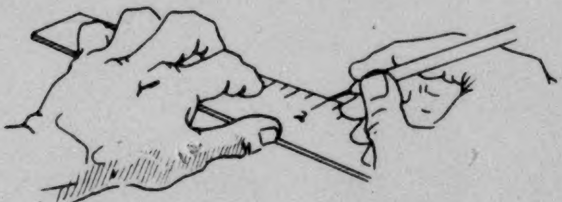
OBJECTIVE: To be able to mark a surface for layout of work lines

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

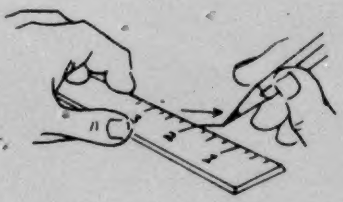
NOTE: This kind of marking requires accuracy, the marks are used in many trade areas.

1. Hold the ruler, tape, or scale firmly in place with the left hand.

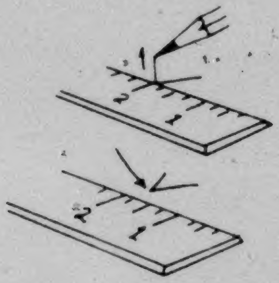


2. Place the point of the pencil or other marking device at the desired location on the surface to be marked.

3. Strike a small mark diagonally to the right.



4. Return the pencil to the original starting point and strike a line diagonally to the left. The resulting point on the V mark is the desired location.



OPERATION SHEET
SC-1-4

COMPETENCY: Using Plastic Angles

COURSE: Metal Fabrication

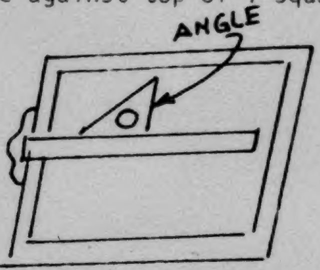
UNIT I: Pattern Drafting and Layout

OBJECTIVE: To position angles to permit drawing of various angled lines

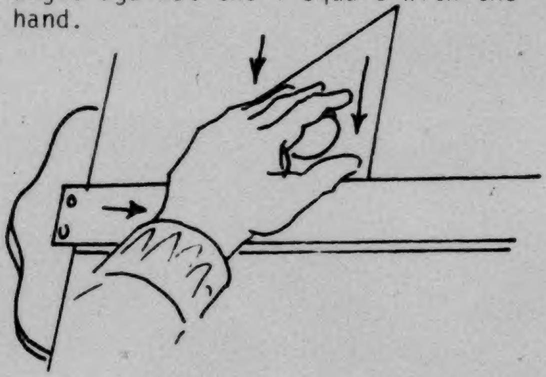
Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

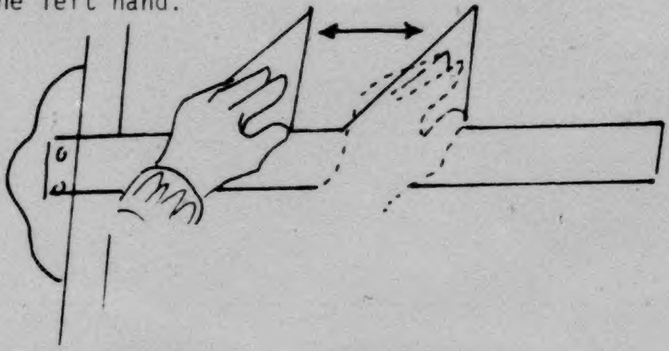
1. Place angle against top of T-square.



2. Hold angle against the T-square with the left hand.



3. Move the angle to the left and right with the left hand.



OPERATION SHEET
SC-1-5

COMPETENCY: Using the Drawing Tools

COURSE: Metal Fabrication

UNIT I: Pattern Drafting and Layout

OBJECTIVE: Proper handling and use of the dividers and compass

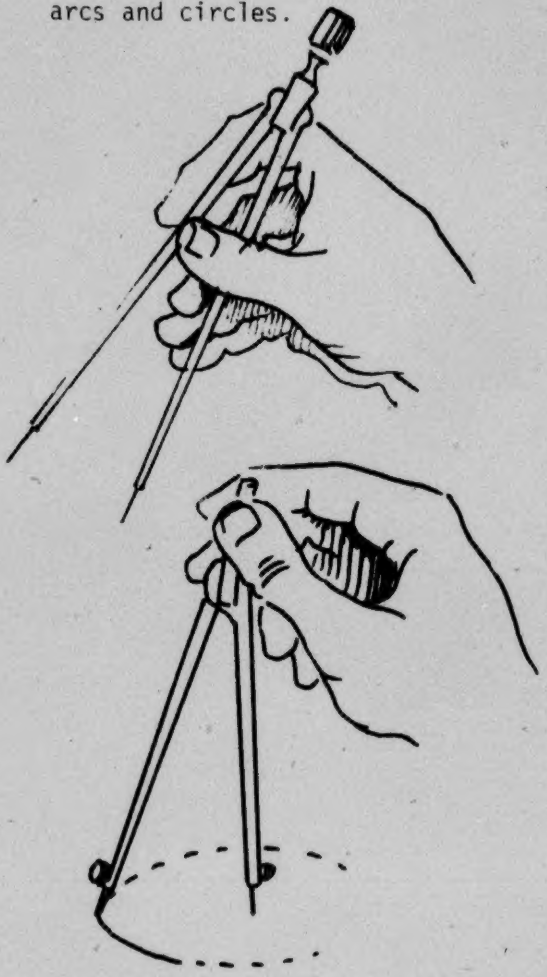
Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

1. Hold the dividers in right hand with thumb on outside of one leg and second finger on outside of other leg.
2. Open and close with one hand by pinching or spreading the chamfer with the thumb and second finger.
3. Rest the head of the compass just above the second joint of the forefinger. (The second and third fingers should be between the two legs.)
4. Draw several short lines any length less than one inch.
5. Using the dividers duplicate the length of these lines.
6. Set compass point so it is slightly longer than pencil or pen.
7. Open and close using same procedure as with dividers.
8. Maintain both points as close to perpendicular as possible when using the compass.

TEACHING/LEARNING ACTIVITIES

Introduction: Dividers are used for transferring measurements and for dividing lines into any number of equal parts. The compass is used to draw arcs and circles.

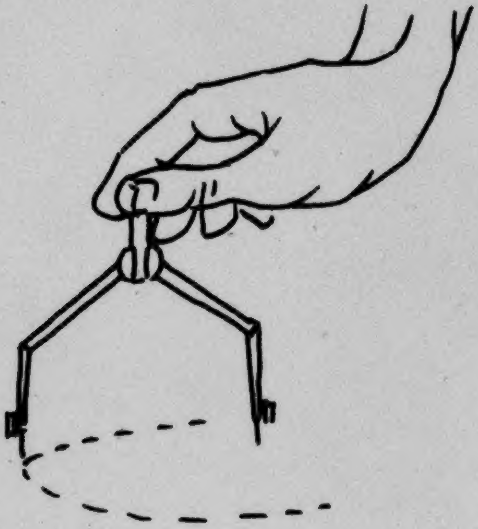


COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES

9. Draw a one-inch and a two-inch line on your paper.

10. Open the compass to the one-inch mark. Insert the point into the board with a little pressure and draw a circle. Draw another circle using a two-inch setting.

11. Check your circles for accuracy. They should measure two inches and four inches across the center.



NOTE: Position thumb and forefinger correctly when performing this operation.

OPERATION SHEET
SC-1-6

COMPETENCY: Using the Architect's Scale

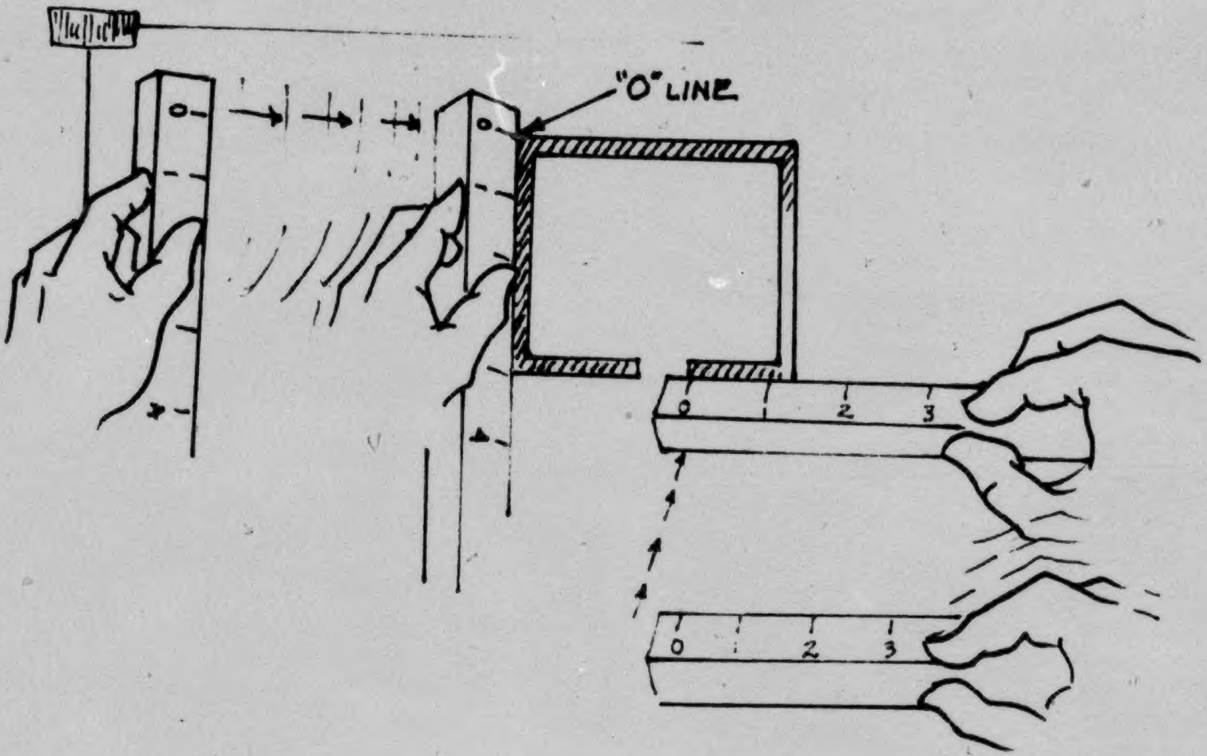
COURSE: Metal Fabrication

UNIT I: Pattern Drafting and Layout

OBJECTIVE: To properly position the scale for correct and accurate measurements

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Slide scale onto paper with left hand (vertically or horizontally).	
2. Align zero "0" line with spot or edge of space to be measured.	



213

OPERATION SHEET
SC-2-1

COMPETENCY: Measuring and Marking with a Bench Rule and Scribe or Pencil

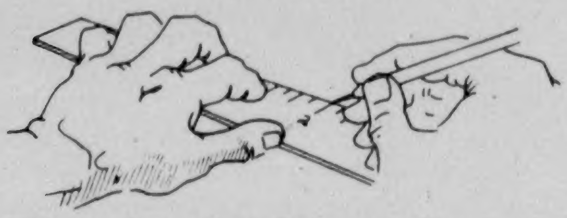
COURSE: Metal Fabrication UNIT II: Fabrication

OBJECTIVE: To develop accuracy on marking to given measurements

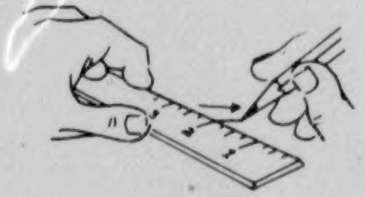
Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
	NOTE: This kind of marking requires accuracy, the marks are used in many trade areas.

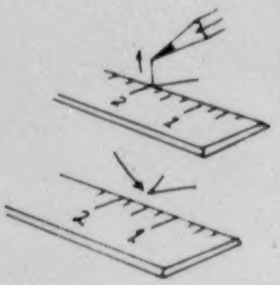
1. Hold the ruler, tape, or scale firmly in place with the left hand.



2. Place the point of the pencil or other marking device at the desired location on the surface to be marked.
3. Strike a small mark diagonally to the right.



4. Return the pencil to the original starting point and strike a line diagonally to the left. The resulting point on the V mark is the desired location.



OPERATION SHEET
SC-2-2

COMPETENCY: Scribing a Line with a Scratch Awl and a Straight Edge

COURSE: Metal Fabrication UNIT II: Fabrication

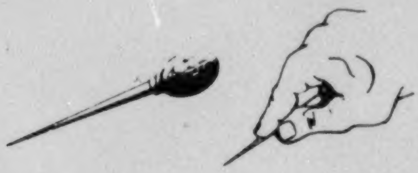
OBJECTIVE: To develop accuracy of scribing to a rule or straight edge

Page 1 of 1 page

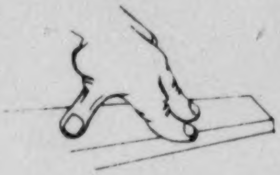
COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

1. Place the straight edge or steel rule on the work in the position to be scribed.

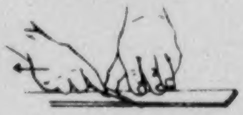
2. Hold the scratch awl in your hand with your index finger stretched out.



3. With the other hand press firmly on the straight edge or rule.



4. Tip the handle of the awl out a little and set the point of the awl as close to the edge of the straight edge as possible.



5. Scribe a line by pushing down on the awl and drawing it along the edge of the straight edge. The handle should be tilted slightly in the direction the awl is to be moved.

OPERATION SHEET
SC-2-3

COMPETENCY: Bending Metal on the Cornice Brake

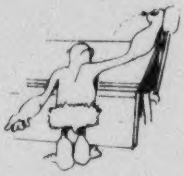
COURSE: Metal Fabrication UNIT II: Fabrication

OBJECTIVE: To accurately aline brake to bend lines and to learn to make bends to the proper degree

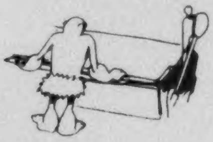
Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

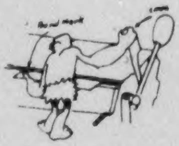
1. Open the right clamping bar by pushing back the clamping bar handle. On a long sheet, open both clamping bars.



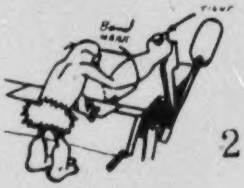
2. Place the sheet between the upper and lower jaws of the machine from the front.



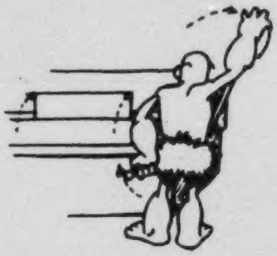
3. Line up the left hand bend mark on the sheet under the edge of the upper jaw. Pull the right clamping bar to firmly hold the left side of the sheet.



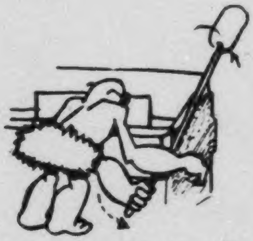
4. Adjust the right hand bend mark with the edge of the upper jaw. Pull the clamping bar to tighten the sheet completely.



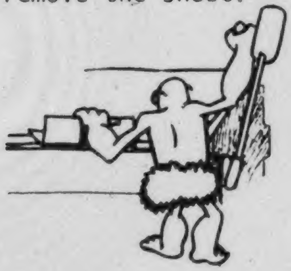
5. With your right and left hands positioned as shown, raise the bending leaf to make the desired bend.



6. Keep your hand on the bending leaf handle and lower it slowly to its beginning position.



7. Open the brake jaws with the clamping handle and remove the sheet.



OPERATION SHEET
SC-2-4

COMPETENCY: Marking Metal with a Prick or Center Punch

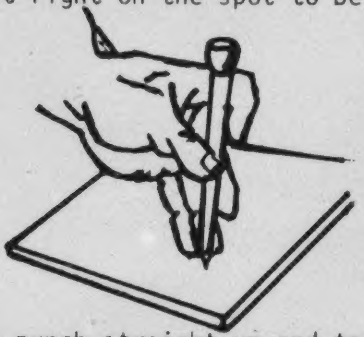
COURSE: Metal Fabrication UNIT II: Fabrication

OBJECTIVE: To efficiently use the prick or center punch

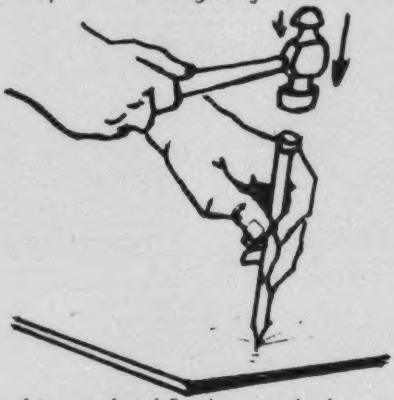
Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

1. Hold the punch in one hand and place the point right on the spot to be marked.



2. Hold the punch straight up and tap the top of it lightly with a hammer.



3. Tap it again if the mark is not deep enough.

OPERATION SHEET
SC-2-5

COMPETENCY: Making a Straight Cut With Straight, Combination or Bulldog Snips

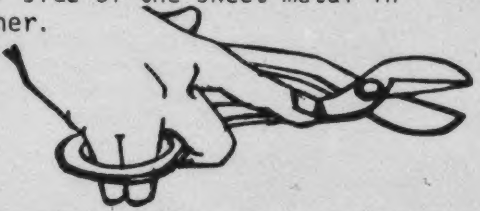
COURSE: Metal Fabrication UNIT II: Fabrication

OBJECTIVE: To become familiar with using the hand snips

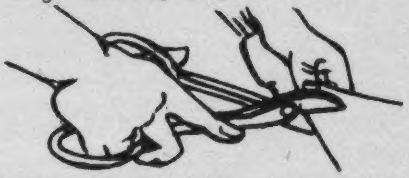
Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

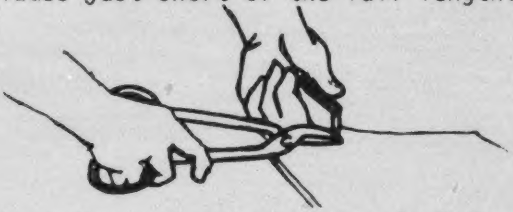
1. Grasp the snips with one hand and the shorter side of the sheet metal in the other.



2. Open the blades wide and start the cut at the edge of the sheet.

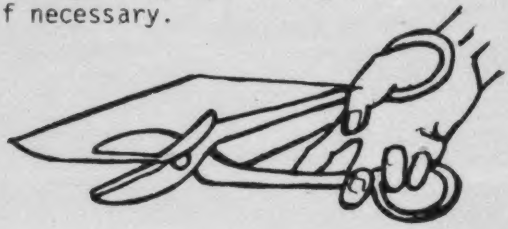


3. Hold the blades of the snips at a right angle to the sheet and cut. Keep from getting jagged edges by closing the blades just short of the full length.



4. Start the next cut at the end of the one before.

5. Finish the cut. Keep the snips on the line by changing the angle of the cut if necessary.



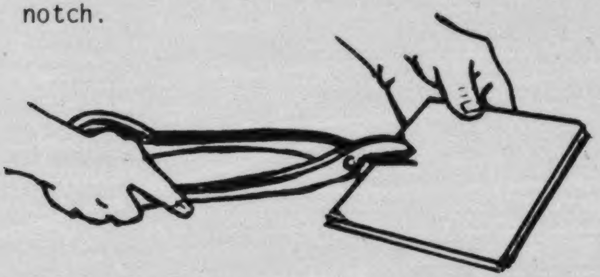
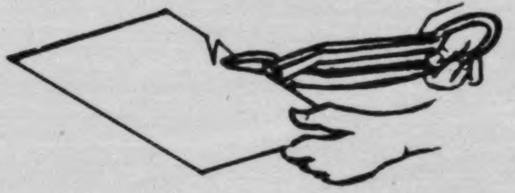
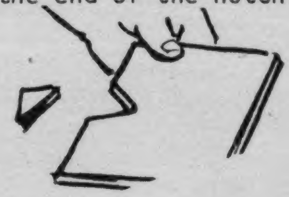
OPERATION SHEET
SC-2-6

COMPETENCY: Notching Metal

COURSE: Metal Fabrication UNIT II: Fabrication

OBJECTIVE: To cut notches without cutting too deeply or leaving ragged edges

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Hold the snips in one hand and the job in the other. You might have to rest the snips and the job on the bench.	
2. Open the blades of the snips and place them on one side of the notch to be cut. Make sure that the end of the blade does not go over the end of the notch. 	CAUTION: Make sure the piece being cut does not fly toward another worker.
3. Squeeze the blades closed making sure you do not cut past the end of the notch. 	
4. Cut the opposite side of the notch. Do not cut past the end of the notch. 	

OPERATION SHEET
SC-2-7

COMPETENCY: Forming Metal on the Bar Folder

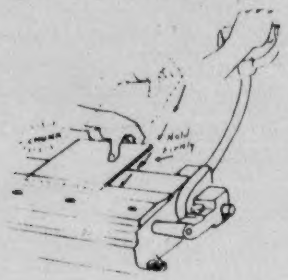
COURSE: Metal Fabrication **UNIT II:** Fabrication

OBJECTIVE: To develop the proper and most efficient ways to use the bar folder

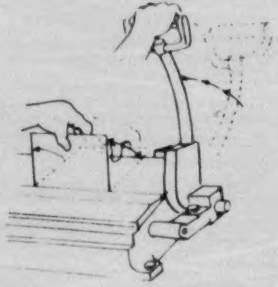
Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

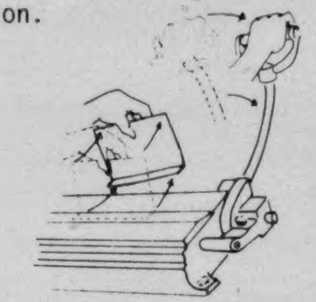
1. Put the edge of the metal to be bent between the jaws of the bar folder. Make sure the edge is tight against the fingers of the bender.
2. Hold the metal firmly against the gage fingers with your left hand.



3. With your right hand, pull the operating handle to the bend angle you want.



4. Without releasing your right hand, slowly return the operating handle to its original position.



5. Remove the metal from the folder.

OPERATION SHEET
SC-2-8

COMPETENCY: Grooving Seams with Hand Groover

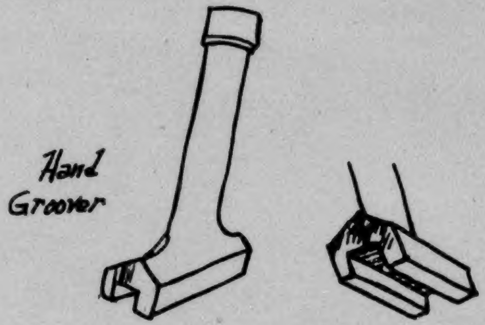
COURSE: Metal Fabrication **UNIT II:** Fabrication

OBJECTIVE: To obtain the feel of the hand groover and through use of it, know when a groove is completed correctly

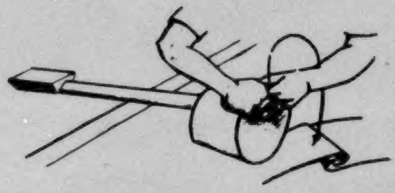
Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

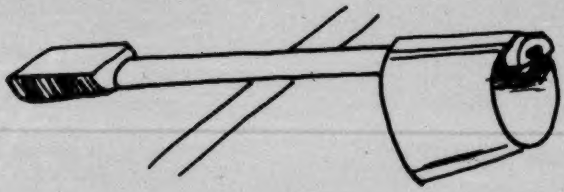
1. Place the job on a suitable bucking surface.

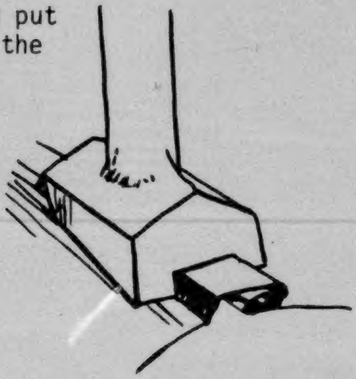


2. Hook the edges of the metal sheet together. Make sure the bottom and top edges meet smoothly.

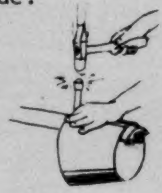


3. Turn the work so the seam is in the center of the bucking surface and put the hand groover over one end of the seam.





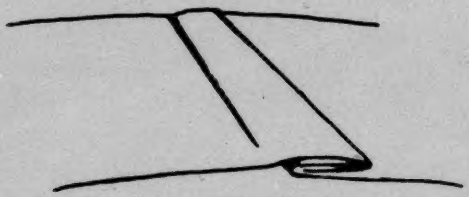
4. Strike the groover with a riveting hammer until a groove is made.



COMPETENCE - PROCEDURE/STEPS | TEACHING/LEARNING ACTIVITIES

5. Make sure the seam at the other end is locked together and repeat steps 3 and 4.

6. Groove the rest of the seam the same way moving the groover about half its length at a time.



OPERATION SHEET
SC-2-9

COMPETENCY: Bending Sides on Box or Pan on the Box and Pan Brake

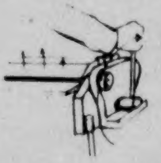
COURSE: Metal Fabrication UNIT II: Fabrication

OBJECTIVE: To properly adjust and use the box and pan brake

Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

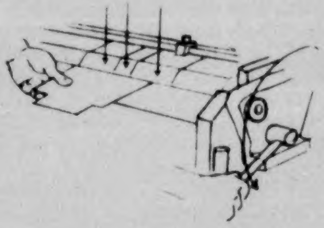
1. Open the brake by raising the operating handle to its highest position.



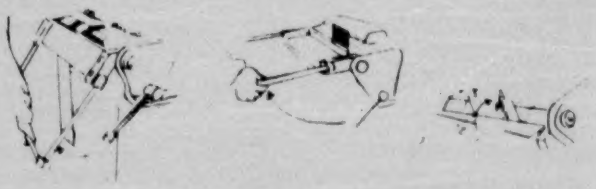
2. Put the work between the jaws from the front of the brake.

3. Put the long side of the sheet in the brake and push down the clamping handle to clamp the metal in place.

NOTE: Be sure the line to be bent is in line with the center of the upper clamping bar jaw.



4. Bend the side 90° by pulling up on the bending leaf handle with your right hand.



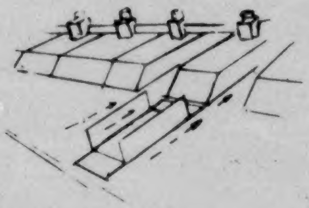
COMPETENCE - PROCEDURE/STEPS — TEACHING/LEARNING ACTIVITIES

5. Raise the clamping handle and remove the job.

6. Bend the opposite side of the box in the same way.

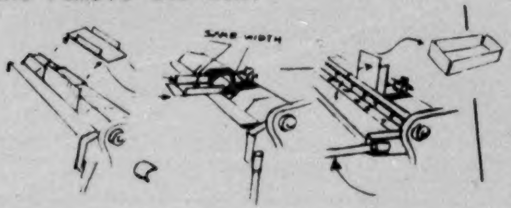
7. Raise the clamping handle to its highest position and remove the work.

8. Remove sections from the upper clamping bar until the section left is as long as the box or pan is wide.



9. Bend the last two sides of the box.

10. Open the brake jaws by raising the clamping handle to its highest position and remove the box.



COMPETENCY: Cutting Outside Curved Cuts With Combination Shears

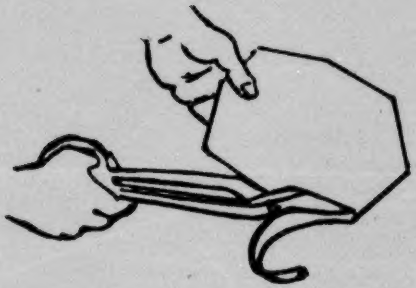
COURSE: Metal Fabrication UNIT II: Fabrication

OBJECTIVE: To manipulate the combination shears so cuts are neat and free of burrs

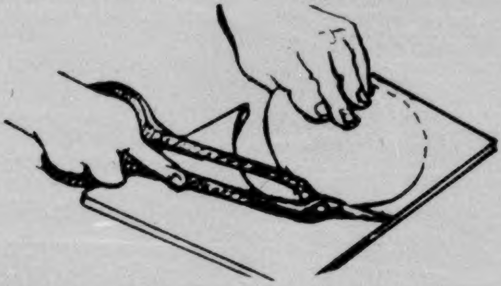
Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

1. Hold the metal in one hand and the shears in the other.



2. Start the cut by squeezing the handle of the shears. Open the shears by hand after the cut is made.



3. While working the shears with one hand, keep turning the metal with the other hand. Keep the blades of the shears straight up and down while you are cutting.

OPERATION SHEET
SC-2-11

COMPETENCY: Cutting Metal with a Hammer and Chisel

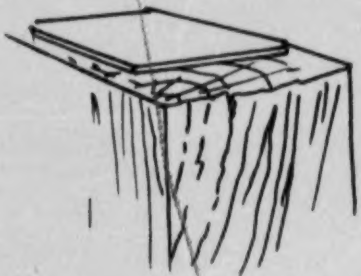
COURSE: Metal Fabrication **UNIT II:** Fabrication

OBJECTIVE: To become aquainted with the proper way of holding the chisel and the proper way of striking the chisel

Page 1 of 1 page

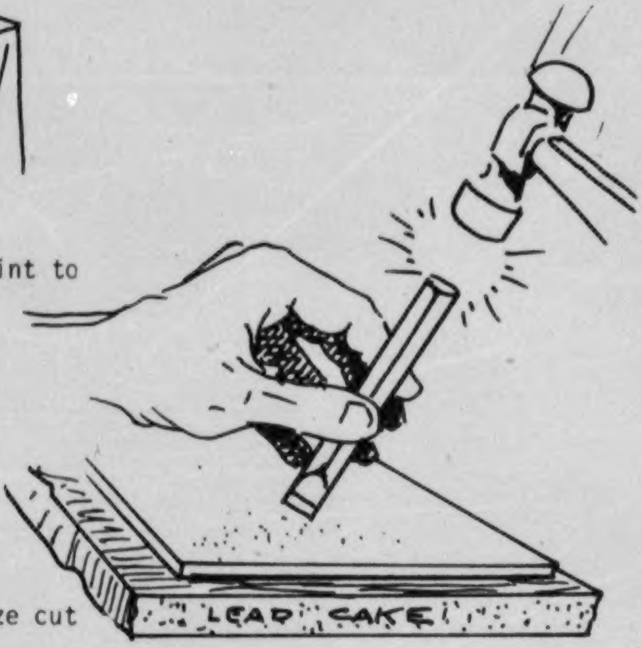
COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

1. Place metal to be cut on a wood block or lead cake.

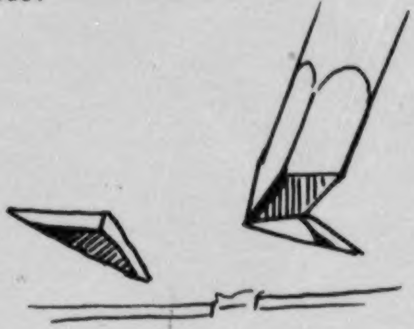


2. Hold chisel in position at the point to be cut.

3. Strike the chisel firmly.



4. Continue striking until proper size cut is made.



OPERATION SHEET
SC-2-12

COMPETENCY: Assembling Wired Edge on Stakes Using Pliers and Setting Down Hammer

COURSE: Metal Fabrication   **UNIT II:** Fabrication

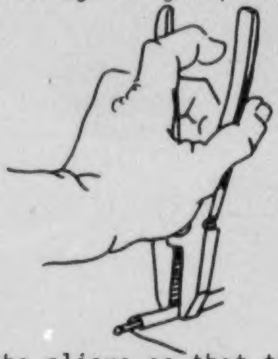
OBJECTIVE: To gain workable knowledge of holding wire in position and setting the metal over the wire in a good workman like manner

Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

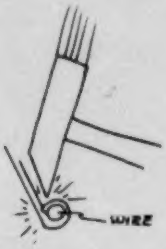
1. Place job over stake so that the edge to be wired is bucked up solidly.

2. Grasp pliers with left hand as shown and open wide enough to grasp wire and metal pocket.

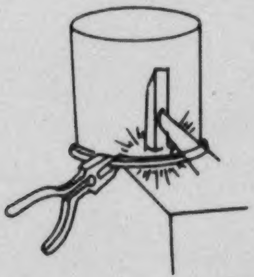


3. Squeeze the pliers so that the wire is pushed back firmly into the pocket of the sheet metal edge.

4. Lock the wire into place by pounding the metal over the wire.



COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
5. Continue around the job until the wire is completely seated into pocket.	



6. Finish the wired edge by pounding the metal over the wire with the setting down hammer (as shown) or on the wiring rolls.

OPERATION SHEET
SC-2-13

COMPETENCY: Making an Inside Curved Cut with Hand Shears

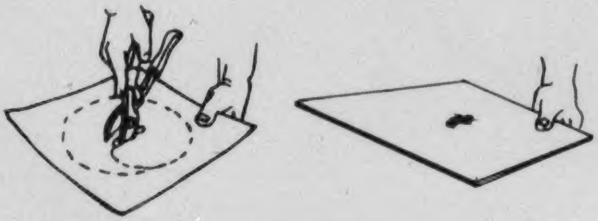
COURSE: Metal Fabrication — UNIT II: Fabrication

OBJECTIVE: To become familar by hands on experience, the most effective way to cut inside curves

Page 1 of 1 page

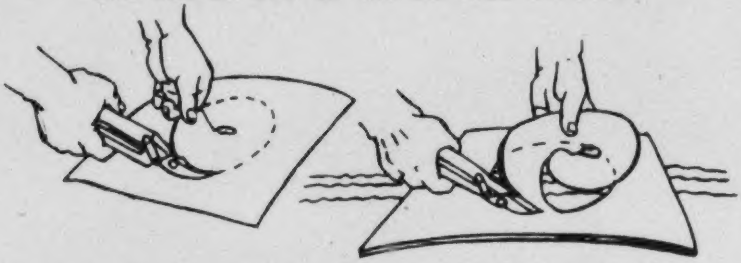
COMPETENCE - PROCEDURE/STEPS
The student will be able to: — TEACHING/LEARNING ACTIVITIES

1. Insert one blade of the shears in the starting slit.



2. Start the cut by squeezing the shears. Relax your hand and they will open automatically.

3. Keep the blades of the shears vertical and cut an arc to the scribed circle.



4. Work the shears with one hand and at the same time turn the metal with the other hand. Cut until the circle is complete.

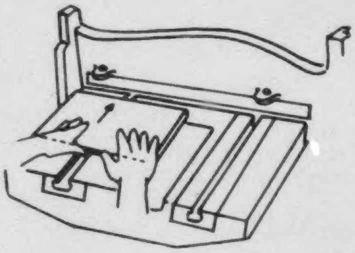
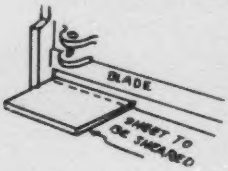
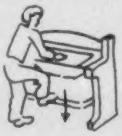
OPERATION SHEET
SC-2-14

COMPETENCY: Shearing Metal in a Foot Squaring Shear

COURSE: Metal Fabrication UNIT II: Fabrication

OBJECTIVE: To safely and efficiently use the foot operated squaring shears

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Adjust or set the back or front gage bar to the width cut you desire.	NOTE: Keep in mind at all times never to place your finger on or near the cutting edge of the blades.
2. Place the metal onto the front shear bed.	
3. Push metal through until it touches adjusted gage. 	
4. Pull down on hold down clamp handles. (These secure metal so it cannot move.)  	NOTE: On some models clamp down is activated by foot treadle.
5. Place your feet on the foot treadle and with body weight and additional pressure quickly force upper cutting blade down until complete cut is made. 	

OPERATION SHEET
SC-2-15

COMPETENCY: Scribing Lines with a Marking Gage

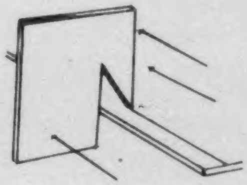
COURSE: Metal Fabrication UNIT II: Fabrication

OBJECTIVE: To develop accuracy on marking with pre-set gages

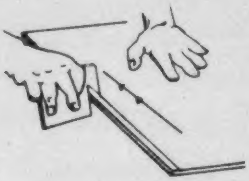
Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

1. Hold the gage against the sheet.
2. Make sure that the front of the gage is perpendicular to the sheet and square against it.



3. Press down and slide the gage along the edge of the sheet.



OPERATION SHEET
SC-2-15A

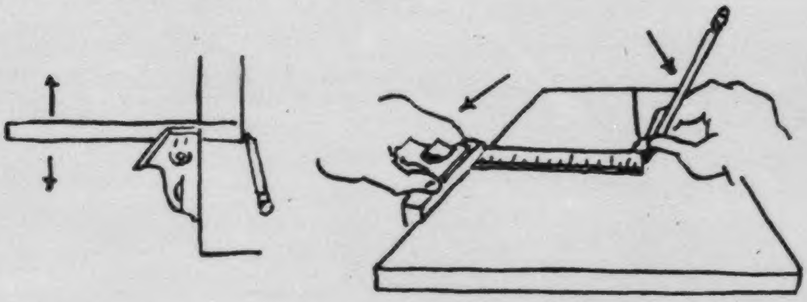
COMPETENCY: Gaging Lines with the Combination Square

COURSE: Metal Fabrication UNIT II: Fabrication

OBJECTIVE: To gain workable knowledge of setting the rule on the square body and to gain effective experience using this tool to scribe lines

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Adjust the blade to the desired measurement.	
2. Place the combination square against the stock.	
3. Place the pencil at the end of the blade and pull the square toward you while marking the stock.	



OPERATION SHEET
SC-2-15B

COMPETENCY: Gaging Lines with a Rule and Pencil

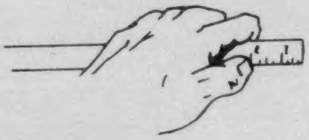
COURSE: Metal Fabrication **UNIT II:** Fabrication

OBJECTIVE: To draw accurate straight lines by guiding the rule with thumb nail and holding the pencil in a certain specified location

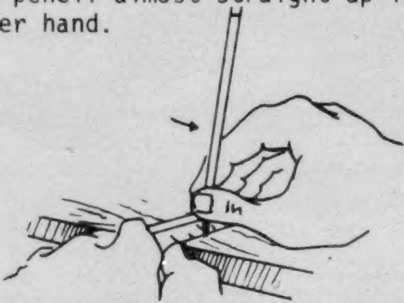
Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

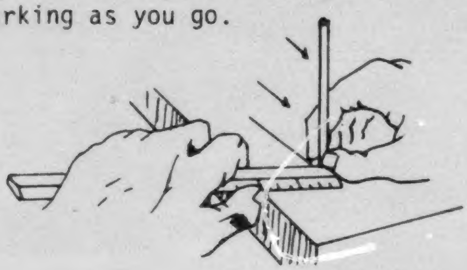
1. Hold your thumbnail on the edge of the rule at the graduation you need.



2. Hold the pencil almost straight up in your other hand.



3. Use your thumbnail as a guide and pull the rule and pencil along the stock marking as you go.



OPERATION SHEET
SC-2-16

COMPETENCY: Forming Cylindrical Shapes on the Slip Roll Forming Machine

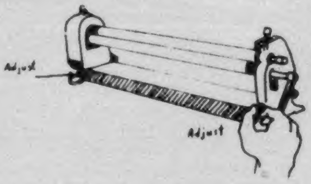
COURSE: Metal Fabrication UNIT II: Fabrication

OBJECTIVE: To learn the proper and efficient use of the slip roll machine

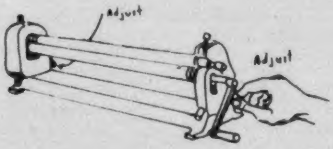
Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

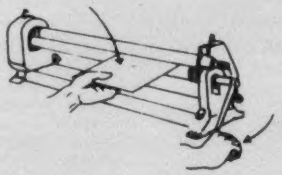
1. Adjust the lower front roll to grip the metal.



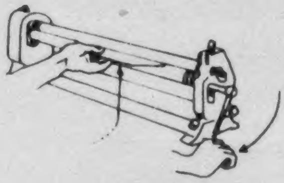
2. Set the back roll.



3. Put the sheet between the rolls from the front of the machine.

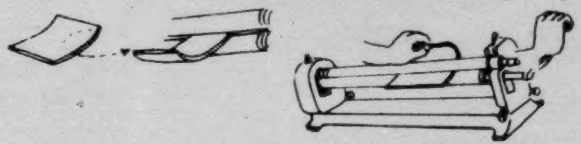


4. Turn the operating handle and start the sheet between the rolls.



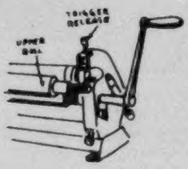
COMPETENCE - PROCEDURE/STEPS | TEACHING/LEARNING ACTIVITIES

5. Hold the operating handle firmly with your right hand. Raise the sheet with your left hand to form a starting edge.

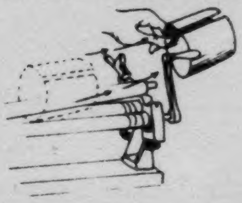


6. Repeat steps 3, 4, and 5 at the other end of the sheet.

7. Turn the operating handle until the sheet is part way through the rolls. Move your left hand to the upper edge of the sheet.



8. Roll the rest of the sheet through the machine.



NOTE: If the diameter is not small enough, tighten the back roll and run the sheet through again.

9. Release the upper roll and remove the job.

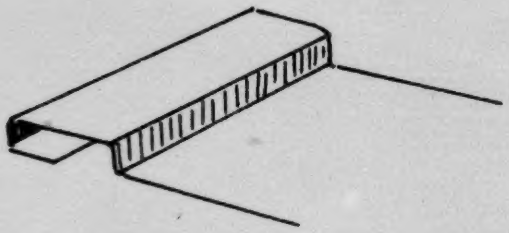
OPERATION SHEET
SC-2-17

COMPETENCY: Forming Pipelock Seam with Machine

COURSE: Metal Fabrication UNIT II: Fabrication

OBJECTIVE: To obtain knowledge of machine, how it is used and the amount of metal needed of form pipelock seam

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Start machine by electric switch. 2. Place workpiece on table of machine with edge against guide and outside of pipe up.	Layout of pipe section must include allowance for seam as required by adjustment of gages on particular machine usually 5/8". Seam is formed with inside of pipe down.
3. Push workpiece into machine rolls until rolls begin to pull piece into machine.	
4. Maintain a pressure to hold piece against guide to insure a straight seam.	
5. When the entire workpiece has cleared the last roll shut the machine off.	

OPERATION SHEET
SC-2-18

COMPETENCY: Using the Double Cutting Shears

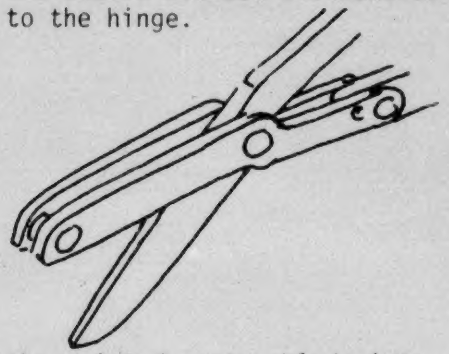
COURSE: Metal Fabrication UNIT II: Fabrication

OBJECTIVE: To cut pipe without waste or metal distortion

Page 1 of 1 page

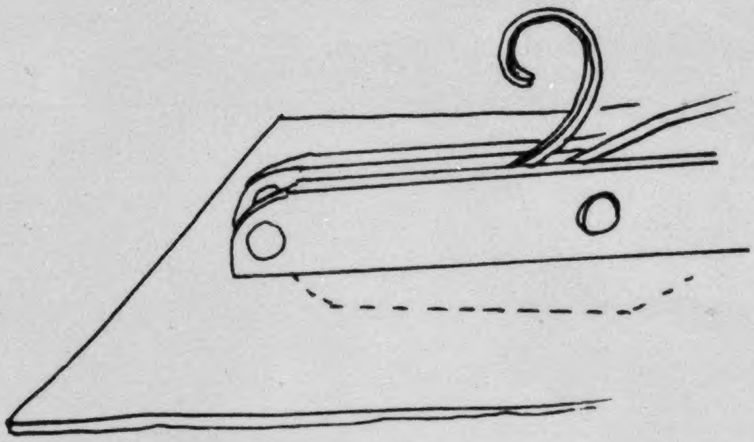
COMPETENCE - PROCEDURE/STEPS
The student will be able to:

1. Grasp the shears between the handles close to the hinge.



2. Press the pointed center blade into the metal with a slight twisting motion. Press until blade pierces through the metal as deep as the blade.

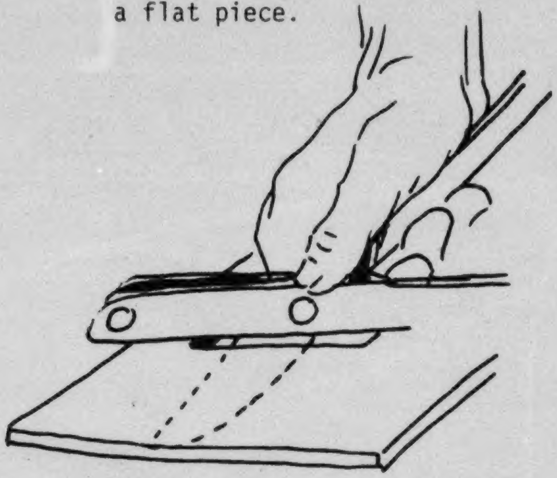
3. Grip the shears by the handles and squeeze. A thin strip will curl up from between the two outer blades.



TEACHING/LEARNING ACTIVITIES

Introduction: Double cutting shears are used in situations where it is not possible to allow the scrap to curl as it comes off the shear.

Examples: Cutting a pipe in two, cutting the center out of a flat piece.



OPERATION SHEET
SC-2-19

COMPETENCY: Crimping Metal with a Combination Rotary Machine

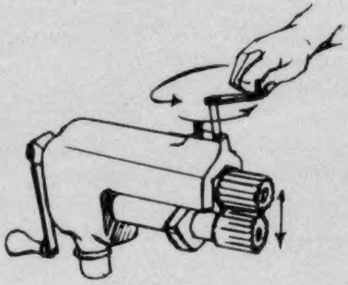
COURSE: Metal Fabrication **UNIT II:** Fabrication

OBJECTIVE: To gain workable knowledge of the crimping machine

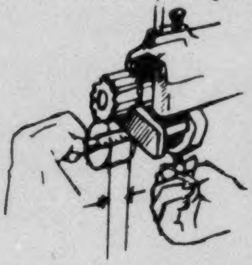
Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

1. Turn the crankscrew and raise the upper roll of the machine enough to get the metal between the rolls.

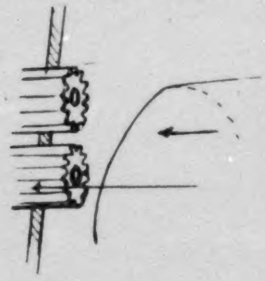


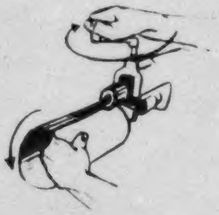
2. Set the gage to the depth you want.



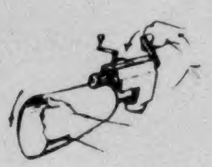
3. Place the edge to be crimped between the rolls and against the gage. The side of the metal should be just past the rolls.

4. Lower the upper roll until you get the depth crimp you want. Turn the crankscrew until the operating handle turns with a little stiffness.





COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
5. Hold the work level against the gage and turn the operating handle until the crimp is made the whole way around.	NOTE: Do not crimp over seams.



6. Raise the upper roll and remove the work.

OPERATION SHEET
SC-2-20

COMPETENCY: Beading with the Combination Rotary Machine

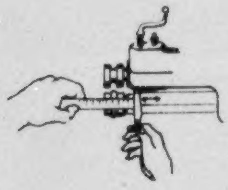
COURSE: Metal Fabrication UNIT II: Fabrication

OBJECTIVE: To properly bead metal and become familar with the beading machine

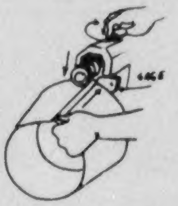
Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

1. Set the gage on the lower arm of the machine to the distance the bead will be from the edge of the work. Do this with a rule or scale. Fasten the gage with the thumb screw.



2. Put the work--just to the right of the seam--between the rolls with the edge of the work tight against the gage.

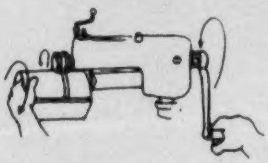


3. Hold the work level with your left hand.

4. Lower the upper roll until the work is held tightly enough to be pulled through the rolls.

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES

5. Keep supporting the work with your left hand and turn the operating handle counterclockwise until you come back to the seam.



6. Remove the work and turn it past the seam.

7. Put the work back in and lower the upper roll a little more. Turn the work around to the seam.

8. Repeat steps 6 and 7 as often as you need to.

9. Remove the work.

OPERATION SHEET
SC-2-21

COMPETENCY: Burring an Edge on the Burring Machine

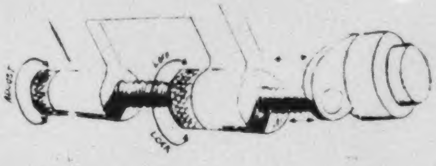
COURSE: Metal Fabrication **UNIT II:** Fabrication

OBJECTIVE: To properly adjust and burr on the burring machine

Page 1 of 2 pages

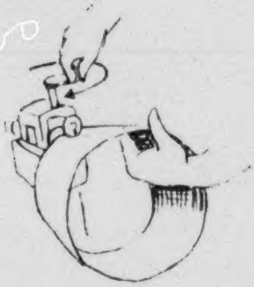
COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

1. Set the gage to the needed depth.
2. Lock the gage in place.

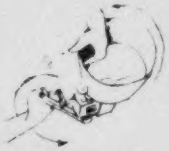


3. Hold the metal in your left hand. Place the edge to be burred between the rolls and against the gage in a position slightly above horizontal.
4. Bring the upper roll down by turning the crankscrew until the metal is held just tight enough to be drawn through the rolls.

NOTE: Do not overtighten the crankscrew or the metal might be cut.

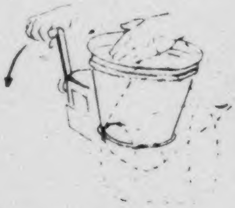


5. Hold the metal against the part of the gage between the rolls and turn the operating handle. Let the metal be drawn through the rolls, but always keep the metal touching the gage.



6. After the metal has gone around once, raise the metal slightly. Make another complete turn.

7. Continue raising and turning the metal until you have the edge angle you want.



8. Turn the crankscrew up to release the metal. Remove the job from the burring machine.

OPERATION SHEET
SC-2-22

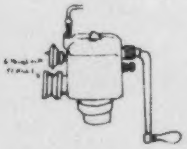
COMPETENCY: Forming an Elbow Lock with a Combination Rotary Machine

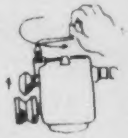
COURSE: Metal Fabrication | UNIT II: Fabrication

OBJECTIVE: To properly adjust and operate the Combination Rotary Machine

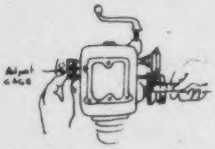
Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Raise the upper roll by turning the crankscrew.	

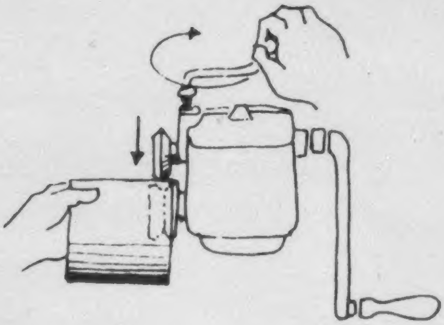




2. Set the gage.	



3. Place the edge to receive the elbow lock between the rollers and against the gage.	
4. Lower the upper roll by turning the crankscrew until the metal is just drawn into the rolls.	NOTE: Do not overtighten the crankscrew.



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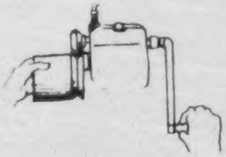
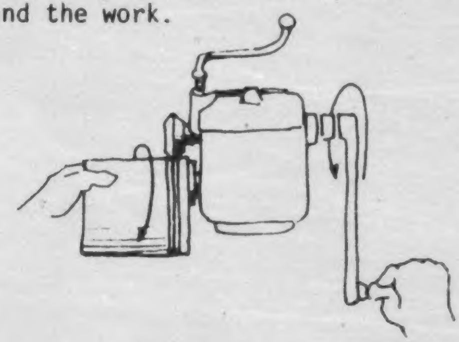
5. Hold the work level and keep it against the gage.

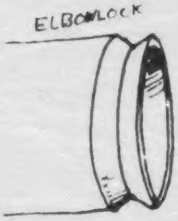


6. Turn the operating handle with your right hand until you make one complete turn around the work.



7. Repeat steps 4, 5, and 6 until the elbow lock is the depth you want it to be.

8. Raise the upper roll and remove the work.



OPERATION SHEET
SC-2-23

COMPETENCY: Punching Holes with Hand Punch

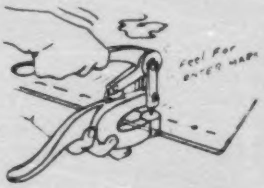
COURSE: Metal Fabrication UNIT II: Fabrication

OBJECTIVE: To place punch in proper location, adjust dies and punch holes cleanly and with minimum manual effort

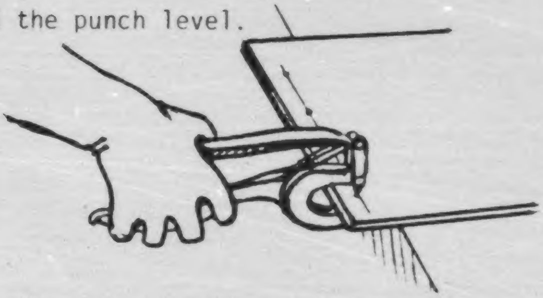
Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

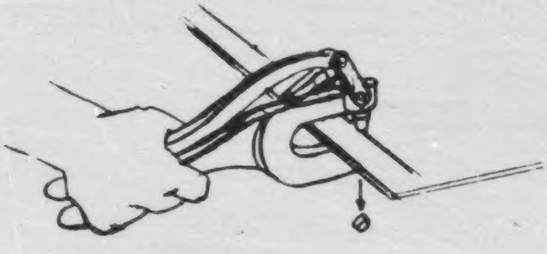
1. Mark the centers of the holes to be punched with a prick punch.
2. Lay the metal to be punched over the edge of the bench.
3. Center the punch point over one of the marks.



4. Hold the punch level.



5. Push the upper handle down until you feel it go through the metal.



OPERATION SHEET
SC-2-24

COMPETENCY: Upsetting a Rivet

COURSE: Metal Fabrication **UNIT II:** Fabrication

OBJECTIVE: To gain workable knowledge of using a riveting set and hammer to upset rivets properly

Page 1 of 2 pages

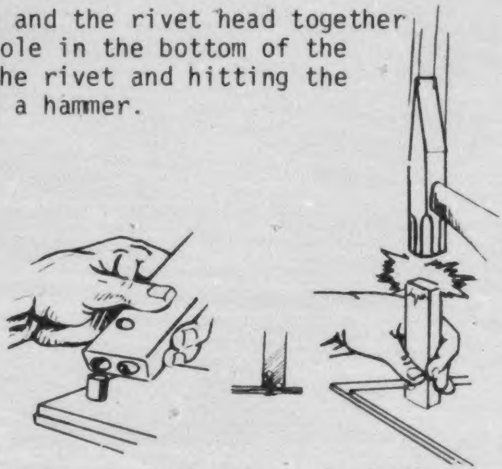
COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

1. Put the job to be riveted on a bucking surface.

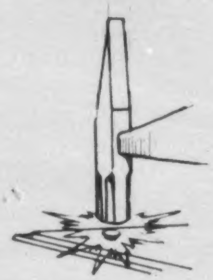
2. Put the rivet through the hole. On long jobs you might have to put the hole in the job over the rivet.

3. Hold the rivet in place with your finger and center the head of the rivet against the bucking surface.

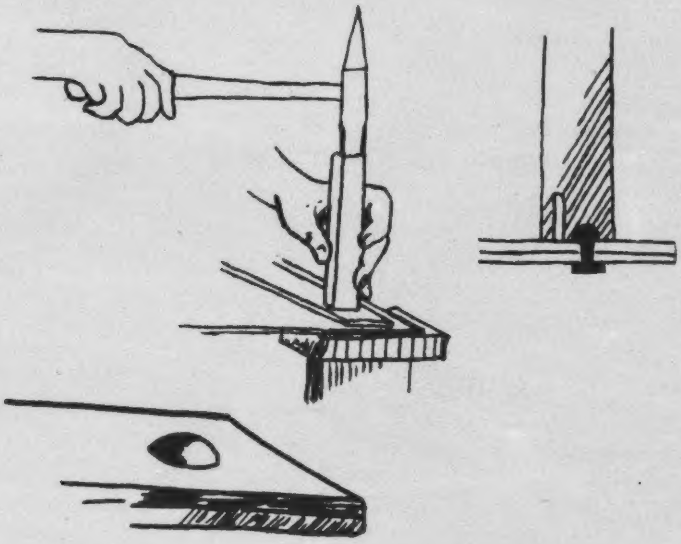
4. Tighten the hole and the rivet head together by setting the hole in the bottom of the rivet set over the rivet and hitting the set sharply with a hammer.



5. Remove the rivet set and strike the end of the rivet squarely with the face of the riveting hammer.



6. Put the cup-shaped hole in the bottom of the rivet set on the rivet and strike the rivet set with the riveting hammer until a good round rivet head is formed.



OPERATION SHEET
SC-2-25

COMPETENCY: Riveting with a Pop Rivet Gun

COURSE: Metal Fabrication

UNIT II: Fabrication

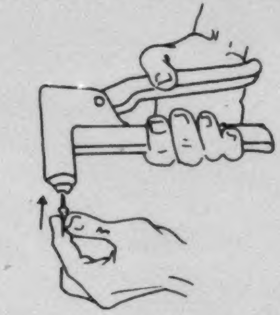
OBJECTIVE: To properly apply rivets with the Pop Rivet gun

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

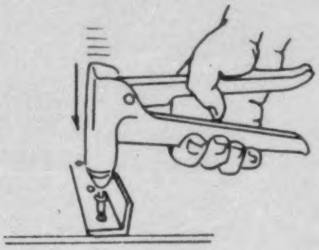
TEACHING/LEARNING ACTIVITIES

1. Open handle completely. Insert rivet mandrel into nosepiece until rivet head is in contact with face of nosepiece.

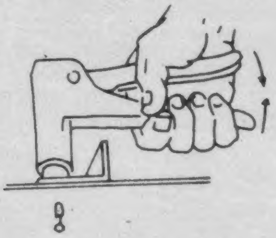


2. Close handle lightly until contact is made between rivet mandrel and riveter jaw. At this point using riveter as a guide, insert rivet into hole of unit to be riveted.

NOTE: Bottom face of rivet head and outer surface of unit to be riveted must be in contact at this time.



3. Squeeze movable handle down until rivet is set.



OPERATION SHEET
SC-2-26

COMPETENCY: Cutting Metal in Power Shears

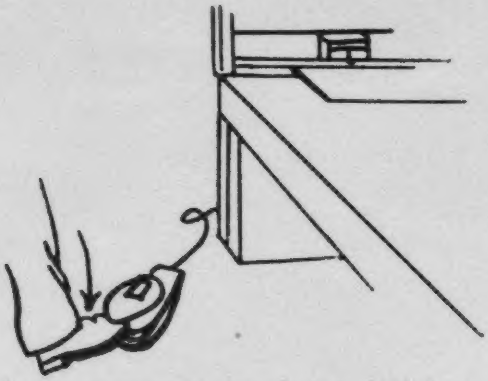
COURSE: Metal Fabrication UNIT II: Fabrication

OBJECTIVE: Safe and efficient use of the power shears

Page 1 of 1

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

1. Turn on power to the machine, (fuse box), but do not start the machine, (button on machine).
2. Adjust and set gages to width of cuts desired
3. Most power shears have gage readings for the back and front setting. (Note: it is always best to check these settings with your rule to be sure they are accurate).
4. Place the metal to be cut on the shear bed.
5. Insert to cut markings or to gage setting.
6. Activate power to the machine.
7. Push down on clutch pedal until upper shear blade comes down and makes its complete cut.



8. Release pressure on clutch pedal

TEACHING/LEARNING ACTIVITIES

INTRODUCTION: The primary purpose of the power shears is to speed up production and make the work easier for the Metal Fabricator. One must keep in mind the potential danger of the power shears and keep safe practice a prime concern at all times.

NOTE: Never cut wire or rod, it can badly damage the shear blade.

OPERATION SHEET
SC-2-27

COMPETENCY: Rolling Metal in Power Rolls

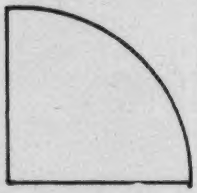
COURSE: Metal Fabrication UNIT II: Fabrication

OBJECTIVE: To safely and effectively use the power rolls, starting, stopping and adjusting

Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

1. Prepare a template of the curvature desired for the finished part.

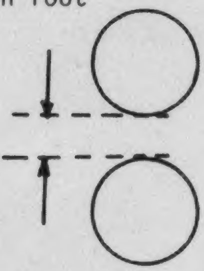


2. Keeping lower roll parallel with upper roll, adjust lower roll to the thickness of the workpiece.

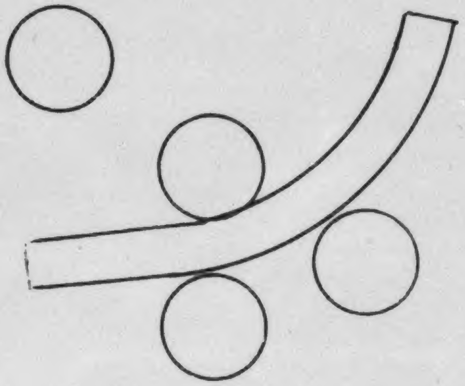
3. Insert workpiece between upper and lower rolls.

CAUTION: Keep fingers from being drawn with workpiece into rolls. Avoid loose clothing that could be caught and drawn into rolls.

4. Activate motor by tramping on foot switch in forward direction.



5. Stop forward rolling of workpiece when sufficient material has passed through the rolls to permit checking curvature with template.



COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
6. If insufficient curvature is noted, reverse rolls by use of foot switch until workpiece disengages rear roll. Then raise rear roll and repeat forward rotation of rolls as step 4. Repeat until workpiece conforms to shape of template.	It is best to work up gradually to the proper curvature because it is easier to increase curvature than to straighten the workpiece after too much curvature is noted.
7. When proper shape is achieved the workpiece can be removed without distortion by releasing the right hand end of the upper roll, raising the right hand end of the upper roll and slipping the workpiece to the right off the upper roll.	Raising rear roll increases curvature - lowering rear roll decreases curvature. There are no exact settings that can be used to achieve a given curvature. The thickness, hardness and type of metal cause variations in results from any particular setting.

OPERATION SHEET
SC-2-28

COMPETENCY: Forming Pittsburgh Lock with Lock Forming Machine

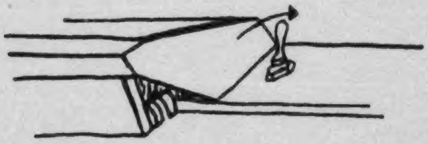
COURSE: Metal Fabrication UNIT II: Fabrication

OBJECTIVE: To learn to use the pittsburgh lock former

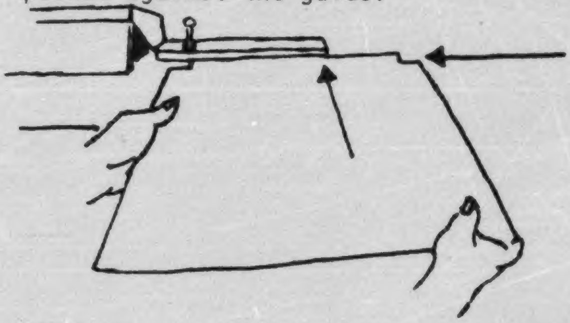
Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

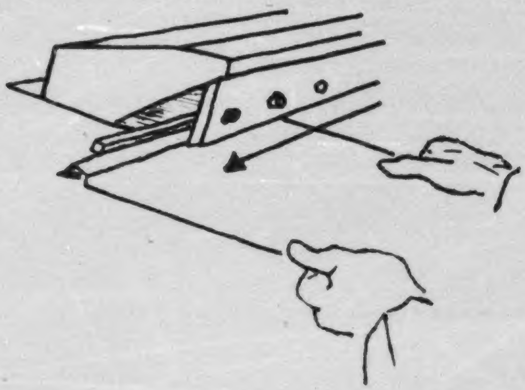
1. Turn on the lock former switch.



2. Put the edge to be made into the lock pocket against the guide.

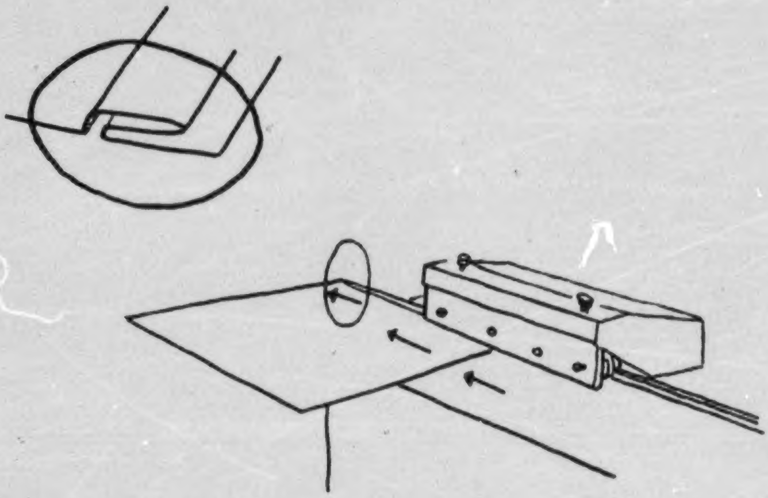


3. Slide the metal into the forming rolls and make sure that the metal stays against the guides at all times.



4. Remove the metal from the lock former and turn off the switch.

5. Start at one end of the job and place the flanged edge into the pocket.



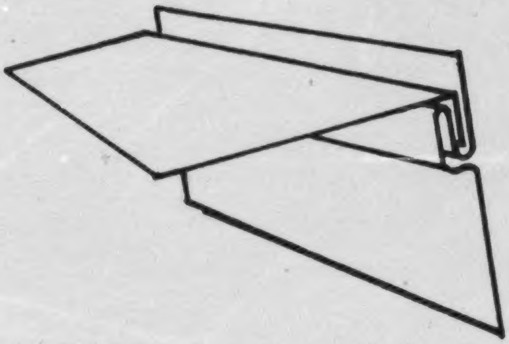
OPERATION SHEET
SC-2-29

COMPETENCY: Assembling Pittsburgh Lock

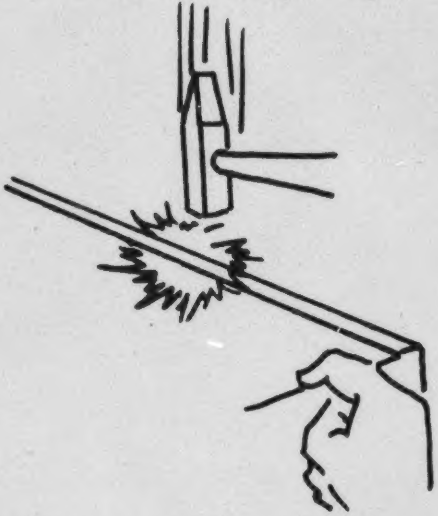
COURSE: Metal Fabrication UNIT II: Fabrication

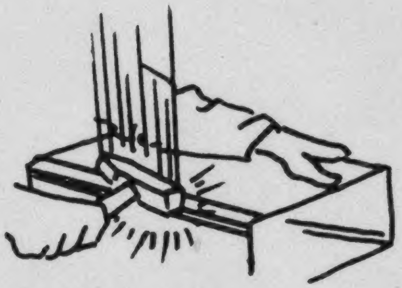
OBJECTIVE: To learn the correct way to assemble the pittsburgh lock

Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Start at one end of the job and place the flanged edge into the pocket.	NOTE: Clamp one end in place with vise grips, complete job, release grips.
	
2. Lock it in place by bending over the edge that is free with a setting down hammer.	
3. Keep working the flange into the pocket with the lock set and setting down hammer until the whole lock is together.	NOTE: On large jobs, you may have to lock the seam from time to time to keep the flange from coming out of the pocket.

4. Using the side of the setting down hammer, finish forming the lock by setting the lip of the pocket tightly over the flanged edge.





OPERATION SHEET
SC-2-30

COMPETENCY: Forming a Flange on the Easy Edger

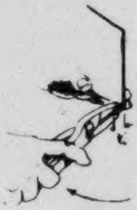
COURSE: Metal Fabrication UNIT II: Fabrication

OBJECTIVE: To properly flange on the easy edger making a smooth curved edge

Page 1 of 2 pages

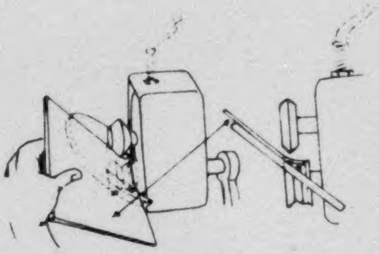
COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

1. With the combination pliers, bend a 90^0 flange as wide as the plier jaws and 3/16" deep.

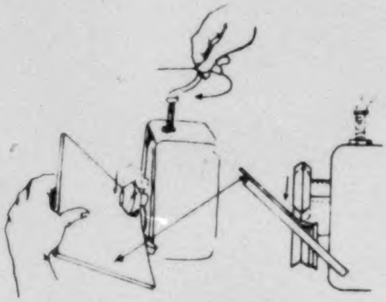


2. Put the flange edge between the rolls on the easy edger with the flange up.

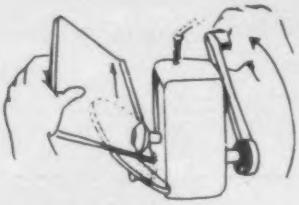
3. Put the corner of the flange in the guide groove of the lower roll.



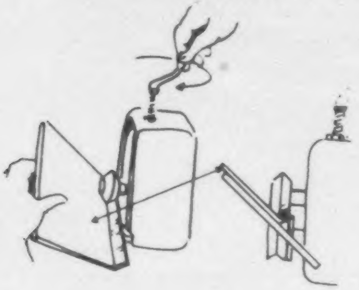
4. Turn the crankscrew handle and bring the upper roll down until tight then release ¼ turn.



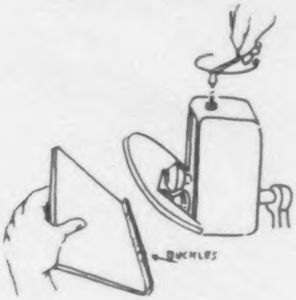
5. Make sure the job rests on the main guide lip. Turn the operating handle until the flange is formed.



6. Release the crankscrew and remove the job.



7. Re-run the job to remove all the buckles and then remove the job from the easy edger.



OPERATION SHEET
SC-2-31

COMPETENCY: Flanging with Power Flanger

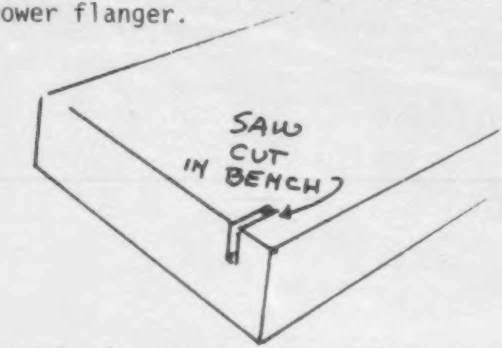
COURSE: Metal Fabrication UNIT II: Fabrication

OBJECTIVE: To use the flanger and become familiar with the way the flanger works

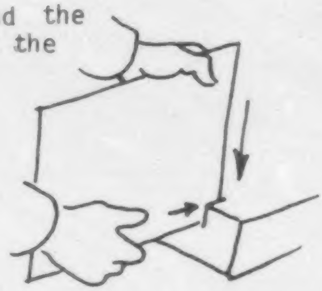
Page 1 of 2 pages

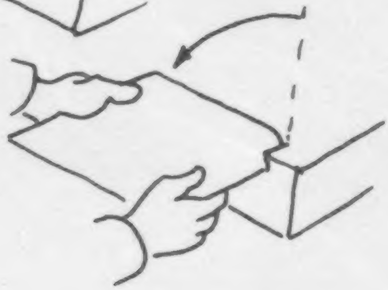
COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

1. Insert leading edge of piece to be flanged into saw cut on edge of table of power flanger.

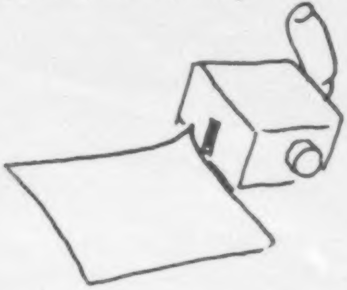


2. Push work piece over. Bend the leading edge over to start the flange.

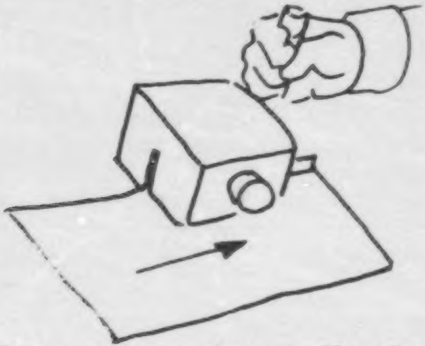




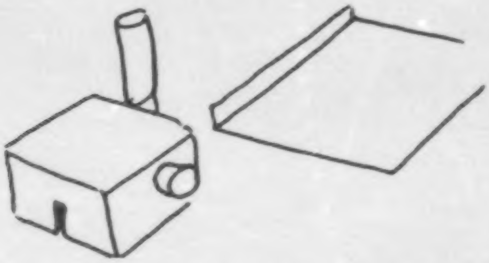
3. Insert started flange, with flange turned up, between forming rolls of flanger.



4. Turn on electric power to start flanger.

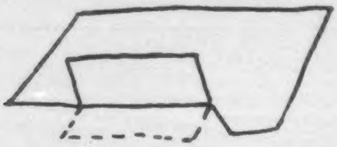


5. As flange appears through flanging rolls hold operating handle of following roller until spring-loaded roll pushes against finished flange.



6. When entire piece has cleared the flanging rolls turn machine off.

5. After the entire width of the metal is bent up 15°-30° begin at the first edge and repeat the operation to bend edge up an additional 15°-30°.
6. Repeat the process of bending a little at a time until desired degree of bend is achieved.



OPERATION SHEET
SC-2-32

COMPETENCY: Bending Metal with Handy Seamer

COURSE: Metal Fabrication

UNIT II: Fabrication

OBJECTIVE: To neatly and efficiently bend metal in the handy seamer

Page 1 of 2 pages

COMPETENCE- PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

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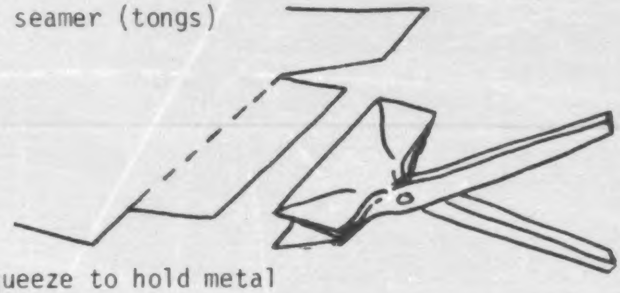
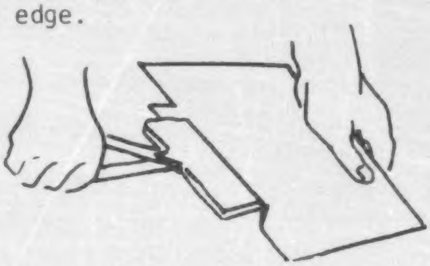
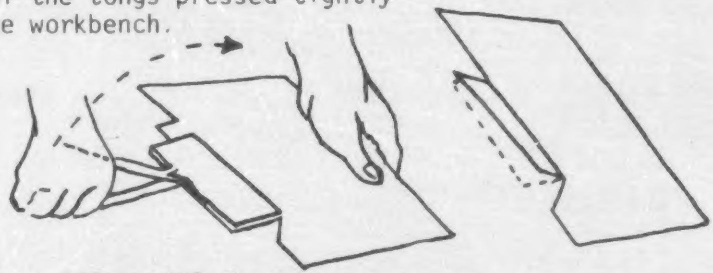
1. Place nose of handy seamer (tongs) on bend line.



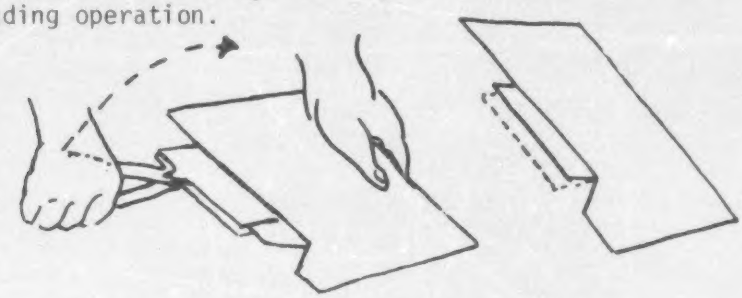
2. Grip handles and squeeze to hold metal tight at one edge.



3. Raise up on the handle, while keeping the nose of the tongs pressed tightly against the workbench.



4. Bend metal up 15° to 30° then move over the width of the tongs and repeat the bending operation.



OPERATION SHEET
SC-2-33

COMPETENCY: Making Drive Cleats by Hand

COURSE: Metal Fabrication   **UNIT II:** Fabrication

OBJECTIVE: To make a series of uniform cleats through the proper practice of cutting and bending

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

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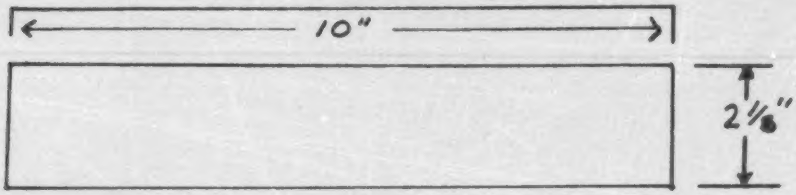
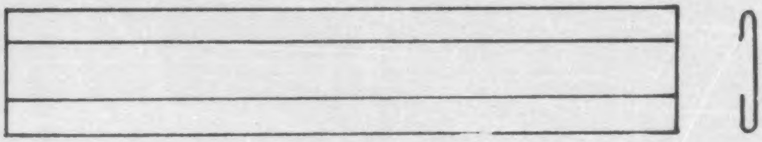
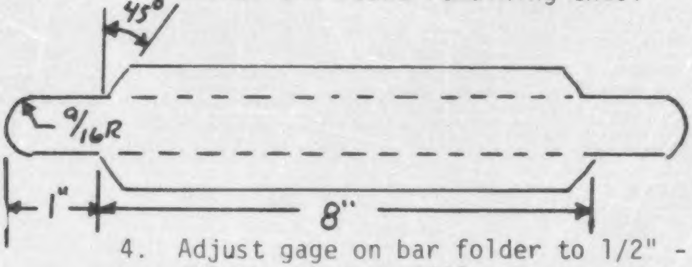
1. For an 8" drive cleat, lay out a metal strip 2 1/8" wide by 10" long.



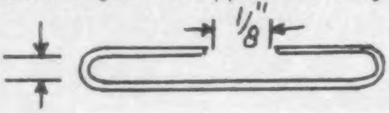
2. Put a bend line 1/2" in from each side.



3. Notch out a 1 x 1/2" piece at each corner and round remaining ends.



4. Adjust gage on bar folder to 1/2" - fold both edges 180° pressing edges down but not too tightly. Check to be sure space between edges is approximately 1/8".



Material should be fairly heavy (22 gage) because cleats must be sturdy enough to permit driving onto duct with a hammer.

OPERATION SHEET
SC-2-34

COMPETENCY: Making "S" Slip

COURSE: Metal Fabrication UNIT II: Fabrication

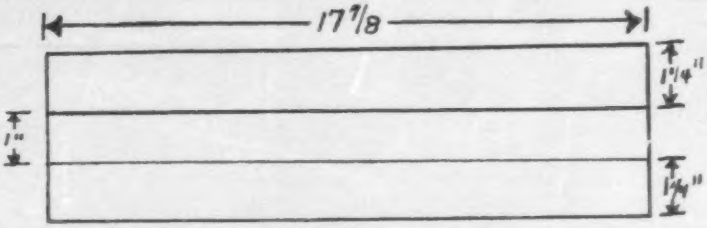
OBJECTIVE: To make "S" slips to join rectangular duct

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

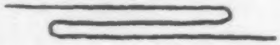
TEACHING/LEARNING ACTIVITIES

1. Lay out a strip of steel 1/8" shorter than width of duct.

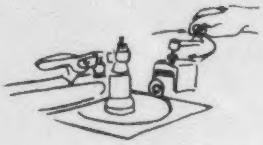


2. Mark across strip 1-1/4" - 1" - 1-1/4" for a total width of 3-1/2".

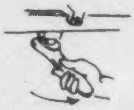
3. Bend the two marks in opposite directions 180° to complete "S" slip.



5. Turn the blank by hand to make sure the cutters are in line with the scribed line on the blank.

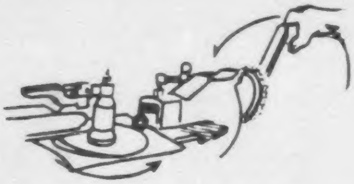


6. Tighten the lock nut on the sliding circle arm.



7. Set the lock nuts on the upper adjustment handle so that the upper cutter makes a clean cut when it is in its lowest position.

8. Turn the operating handle with your right hand until the circle has been cut.



9. Release the clamping handle and remove the disc.

OPERATION SHEET
SC-2-35

COMPETENCY: Shearing Circular Shapes on Ring and Circle Shears

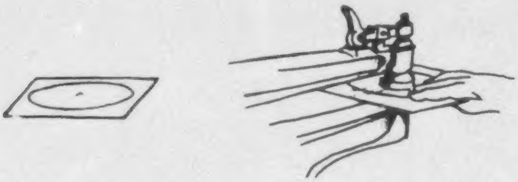
COURSE: Metal Fabrication UNIT II: Fabrication

OBJECTIVE: To learn the proper use of the ring and circle shear

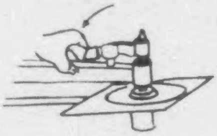
Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

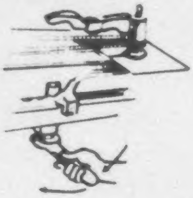
1. Hold the blank in your right hand. Put the prick punch mark on the center point of the lower clamping disc.



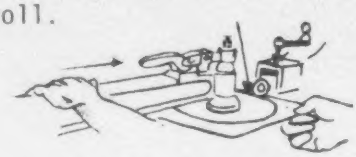
2. Clamp the blank in place by pushing the clamping handle down with your left hand.



3. Loosen the lock nut on the sliding circle arm.



4. Slide the circle arm so that the edge of the scribed circle on the blank is flush with the cutting edge of the upper cutting roll.



OPERATION SHEET
SC-2-36

COMPETENCY: Soldering a Seam with a Soldering Iron

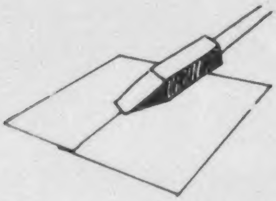
COURSE: Metal Fabrication UNIT II: Fabrication

OBJECTIVE: To learn the correct methods used when soldering with a soldering iron

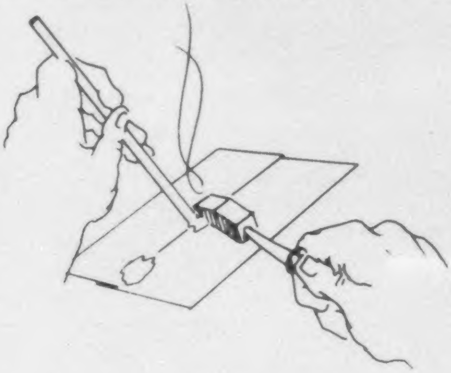
Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

1. Put the job in position on a support.



2. Apply the soldering flux, to the area to be soldered only, with an acid swab.
3. Grasp the heated soldering iron by the handle and clean the tinned surface by quickly dipping only the tinned tip into the dipping solution.
4. Hold the iron at one end of the seam until the solder flows easily into the joint to tack the joint in place.



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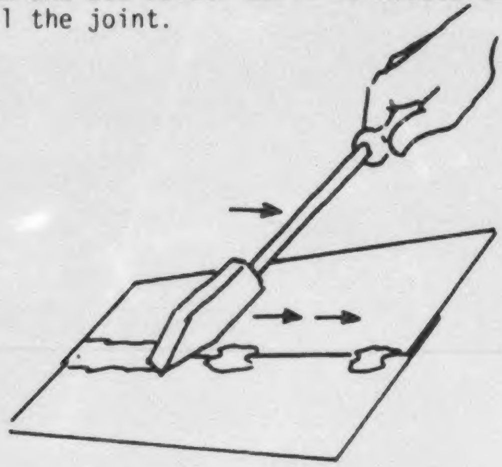
COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
5. Tack the seam where necessary to hold the joint in place.	
6. Hold the soldering iron at one end of the seam. Draw the iron toward you along the seam and add solder as it is needed to fill the joint.	



OPERATION SHEET
SC-2-36A

COMPETENCY: Soft Soldering with Torch

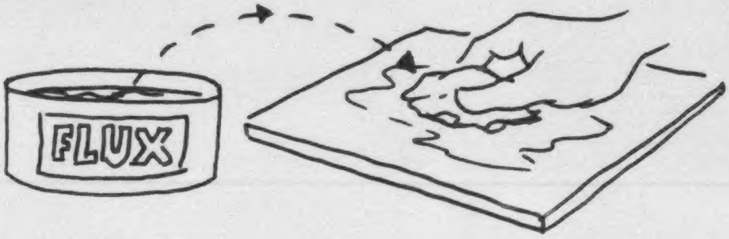
COURSE: Metal Fabrication

UNIT II: Fabrication

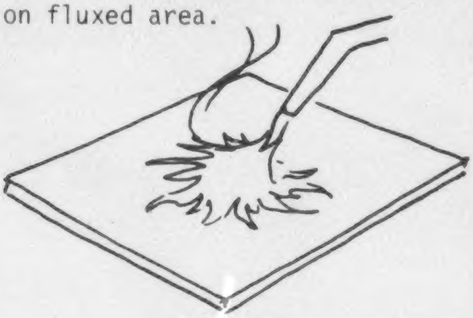
OBJECTIVE: To become familiar with flame heat for the purpose of soft soldering

Page 1 of 2 pages

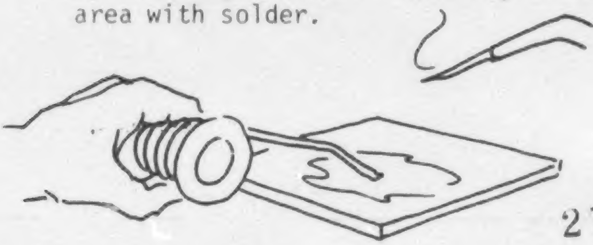
COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Thoroughly clean area to be soldered. Apply appropriate flux.	



2. Apply torch flame to area to be soldered. Avoid concentrating flame directly on immediate area to be soldered. Apply heat around area so that area will be heated but a minimum of oxidation will occur on fluxed area.



3. Test for correct temperature occasionally by removing flame and touching fluxed area with solder.



COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
4. When sufficient temperature is attained solder will flow onto heated area.	REMEMBER: Solder flows toward the heat so if you want more solder in a particular location, apply more heat there, then add solder.

OPERATION SHEET
SC-2-37

COMPETENCY: Forming Metal on Bench Stakes

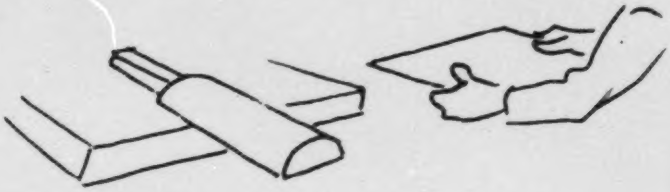
COURSE: Metal Fabrication UNIT II: Fabrication

OBJECTIVE: To properly and neatly form metal on the bench stakes

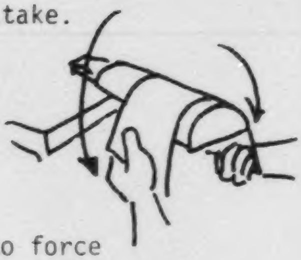
Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

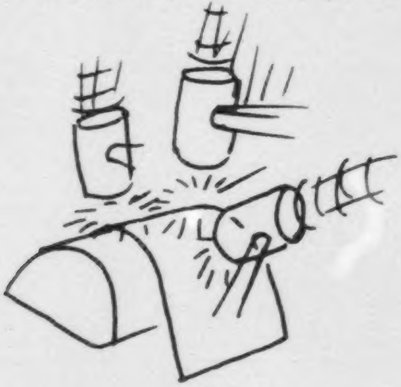
1. Select a stake as near as possible to the shape desired for the sheet metal.



2. Press the metal down over the stake.



3. Use light blows with a mallet to force the metal to conform to the shape of the stake.



OPERATION SHEET
SC-2-38

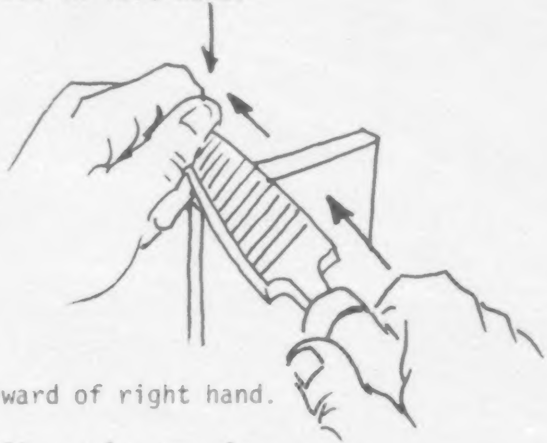
COMPETENCY: Filing Metal By Hand

COURSE: Metal Fabrication UNIT II: Fabrication

OBJECTIVE: To learn the proper filing procedures, push filing

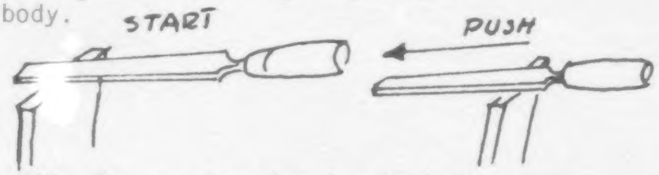
Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Stand in a comfortable position.	
2. Hold handle of file in right hand.	
3. Lightly hold tip of file in left hand.	

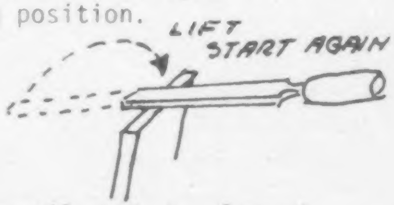


4. Left hand is well forward of right hand.

5. Use pushing motion filing only away from your body.



6. Raise file from work and bring back to original starting position.



7. Repeat procedure until work is cleaned and smoothed to desired necessity.

OPERATION SHEET
SC-2-38A

COMPETENCY: Draw Filing

COURSE: Metal Fabrication

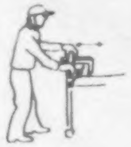
UNIT II: Fabrication

OBJECTIVE: To apply proper filing procedures

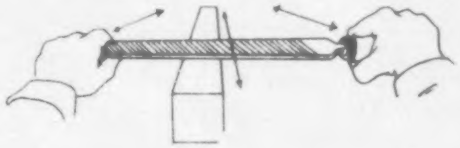
Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

1. Stand in a comfortable position with your feet slightly apart and your left foot forward (if you are right handed).



2. Hold the handle of the file with your right hand and the point with your left hand.



3. Hold the file at a right angle to the work and push down lightly on the work.

4. Push and pull the file across the work; keep it square and flat.

OPERATION SHEET
SC-2-39

COMPETENCY: Cutting with a Hack Saw

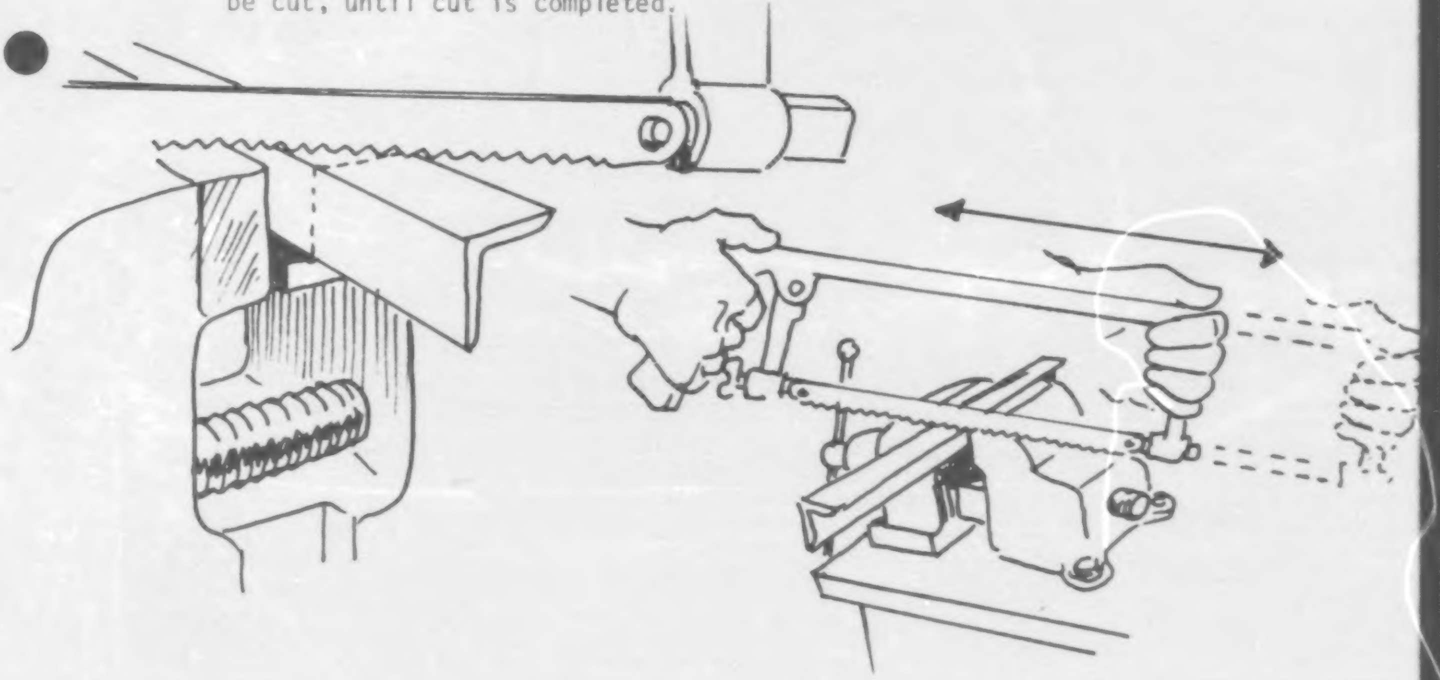
COURSE: Metal Fabrication

UNIT II: Fabrication

OBJECTIVE: To properly use the hack saw

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select a blade with teeth fine enough so that at least 3 teeth will be in contact with the metal to be cut.	
2. Bring blade in contact with the work at an angle.	
3. Using slow strokes the entire length of the blade cut without bearing down on the saw.	
4. Continue making long slow strokes. The harder the metal, the slower it should be cut, until cut is completed.	



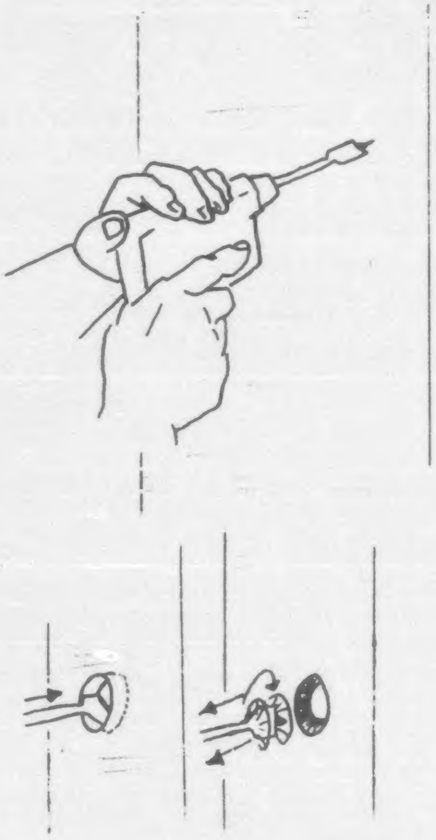
OPERATION SHEET
SC-2-40

COMPETENCY: Drilling Holes with Electric Hand Drill

COURSE: Metal Fabrication UNIT II: Fabrication

OBJECTIVE: To learn the safe and proper methods used when drilling with the electric hand drill

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Place drill bit on punch mark. 2. Squeeze the trigger and apply firm pressure to drill. 3. Apply oil occasionally. 4. Continue drilling to desired depth.	

OPERATION SHEET
SC-2-41

COMPETENCY: Tightening and Loosening Screws with Flat Screwdriver

COURSE: Metal Fabrication UNIT II: Fabrication

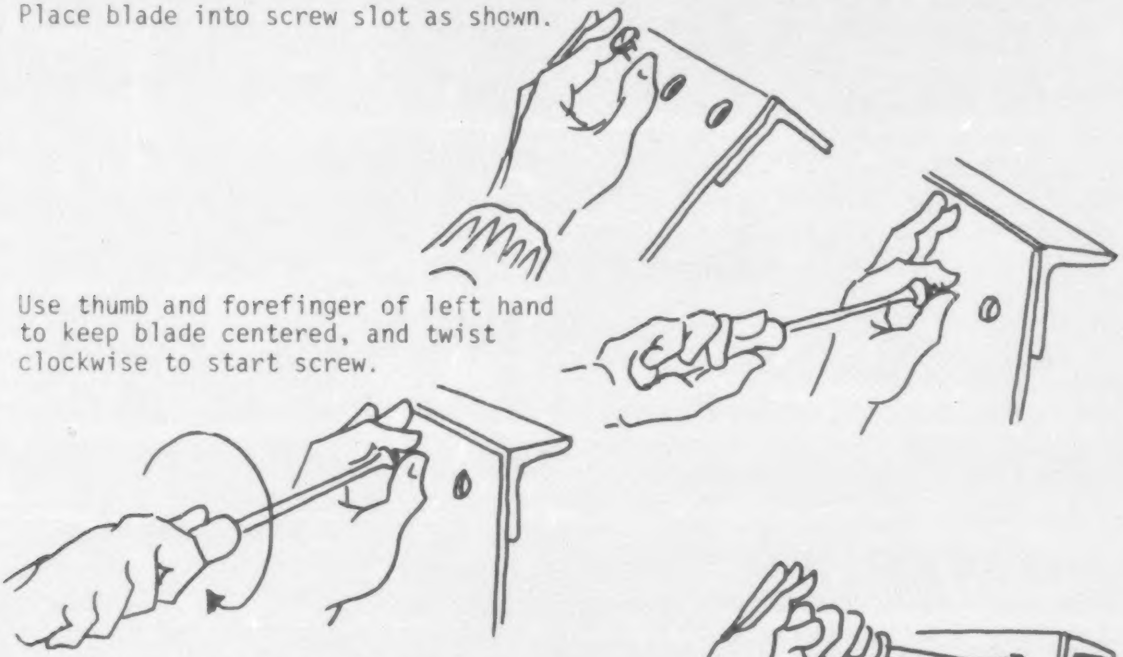
OBJECTIVE: To use a screwdriver and what sizes to use

Page 1 of 2 pages

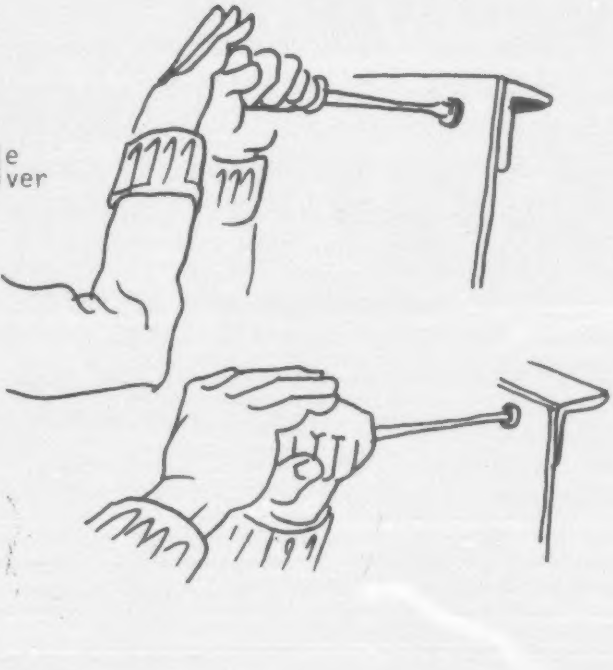
COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

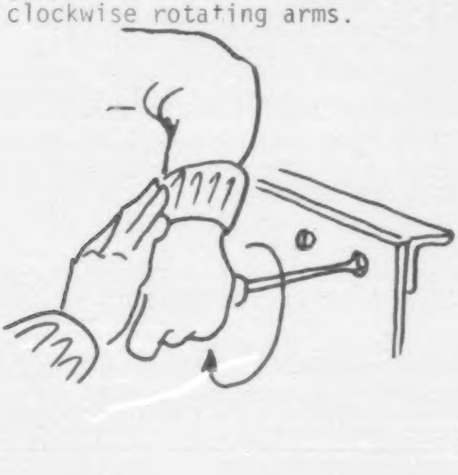
1. Place blade into screw slot as shown.

2. Use thumb and forefinger of left hand to keep blade centered, and twist clockwise to start screw.



3. With the end of handle of screwdriver cupped in palm of right hand and handle gripped with left hand, twist screwdriver clockwise rotating arms.





COMPETENCE - PROCEDURE/STEPS

TEACHING/LEARNING ACTIVITIES

4. Relax hands, twist hands counterclockwise slipping around screwdriver handle.
5. Continue steps 3 and 4 until screw snugs down.
6. Reverse steps 3 and 4 to loosen.

OPERATION SHEET
SC-2-42

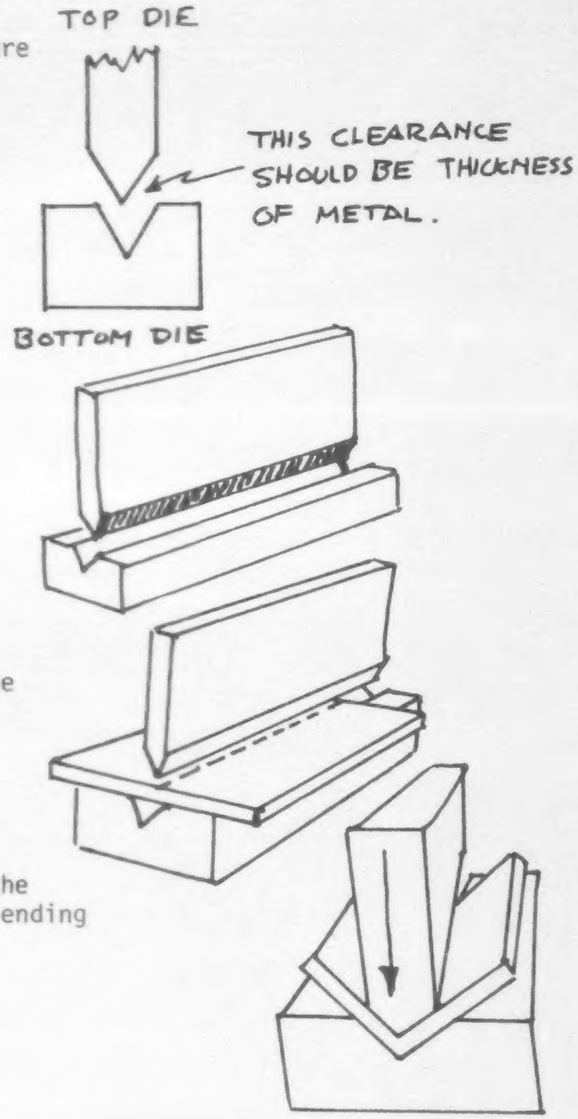
COMPETENCY: Bending Metal in Press Brake

COURSE: Metal Fabrication **UNIT II:** Fabrication

OBJECTIVE: Correctly learn the procedures necessary to operate the power press brake

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES



1. Check and be sure upper and lower dies are correctly installed.
2. Turn the power on and adjust dies to thickness of metal to be bent.
3. Set your bevel square to the degree bend desired.
4. Insert scrap piece of metal into the brake dies. Bend it by operating the upper die with the foot pedal.
5. Check bend and make adjustments using the number or thousandths calibrations on the dial.
6. Bend another scrap piece of metal to be sure you now have the desired angle.
7. Place working piece into brake placing the bend line exactly in the center of the bending dies.
8. Again activate brake and bend.

OPERATION SHEET
SC-2-43

COMPETENCY: Using the Pedestal Grinder

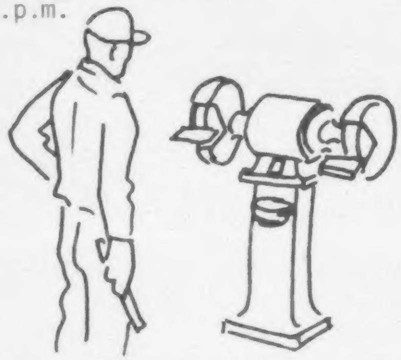
COURSE: Metal Fabrication UNIT II: Fabrication

OBJECTIVE: To safely and effectively operate the grinder

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

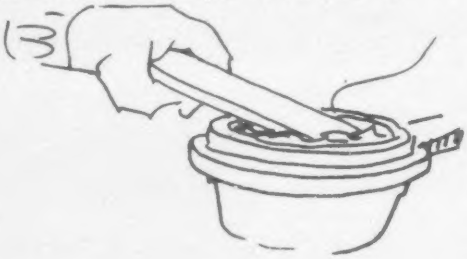
1. Stand back while starting pedestal grinder. If grinding wheels are defective they will most likely explode when grinder is attaining maximum r.p.m.



2. Hold workpiece firmly against wheel with even, steady pressure.

3. Move workpiece slowly across area to be ground to prevent overheating in one area.

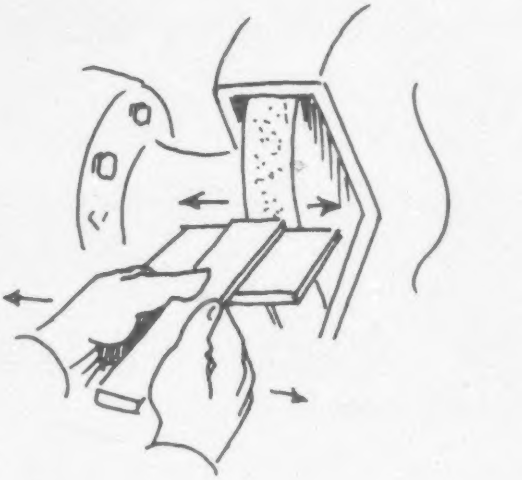
4. Dip workpiece in coolant often to prevent overheating, discoloration, and loss of temper condition.



NOTE: Be sure rests are set within 1/8" of wheel to prevent workpiece from passing through between rest and wheel.

Always wear eye protection when operating grinder.

NEVER grind nonferrous metals on pedestal grinder.



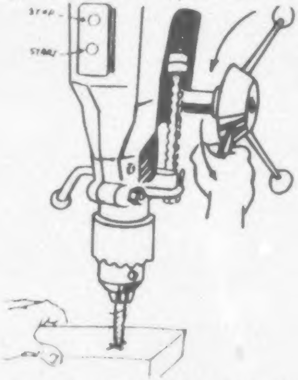
OPERATION SHEET
SC-2-44

COMPETENCY: Drilling Holes in Metal on the Drill Press

COURSE: Metal Fabrication — UNIT II: Fabrication

OBJECTIVE: To use the drill press properly

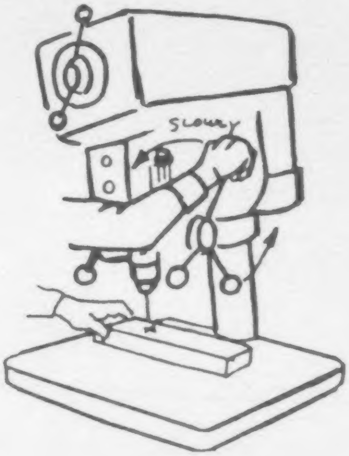
Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Hold the stock firmly with your left hand--or clamp if necessary.	
2. Turn on the motor. Turn the feed lever (pilot wheel) counterclockwise to bring the bit close to the surface of the stock.	
3. Move the stock to line up with the lay-out mark. 	
4. Feed the bit into the work slowly with smooth, even pressure.	NOTE: Add cutting fluid when you are cutting metal.
5. Ease off the pressure when the bit is about to break through the back of the stock.	

6. Raise the bit slowly until it clears the work. Release the feed lever. This will automatically return the drill to the "up" position.

7. Stop the machine.

8. Return all bits and cutters to their proper places, then clean the machine.



OPERATION SHEET
SC-2-45

COMPETENCY: Smoothing and Shaping Metal Using File

COURSE: Metal Fabrication UNIT II: Fabrication

OBJECTIVE: To smooth metal and remove excess metal smoothly

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

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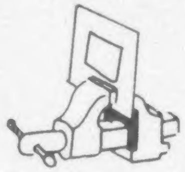
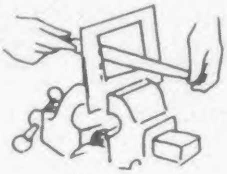
1. Firmly secure metal in machinist vise.

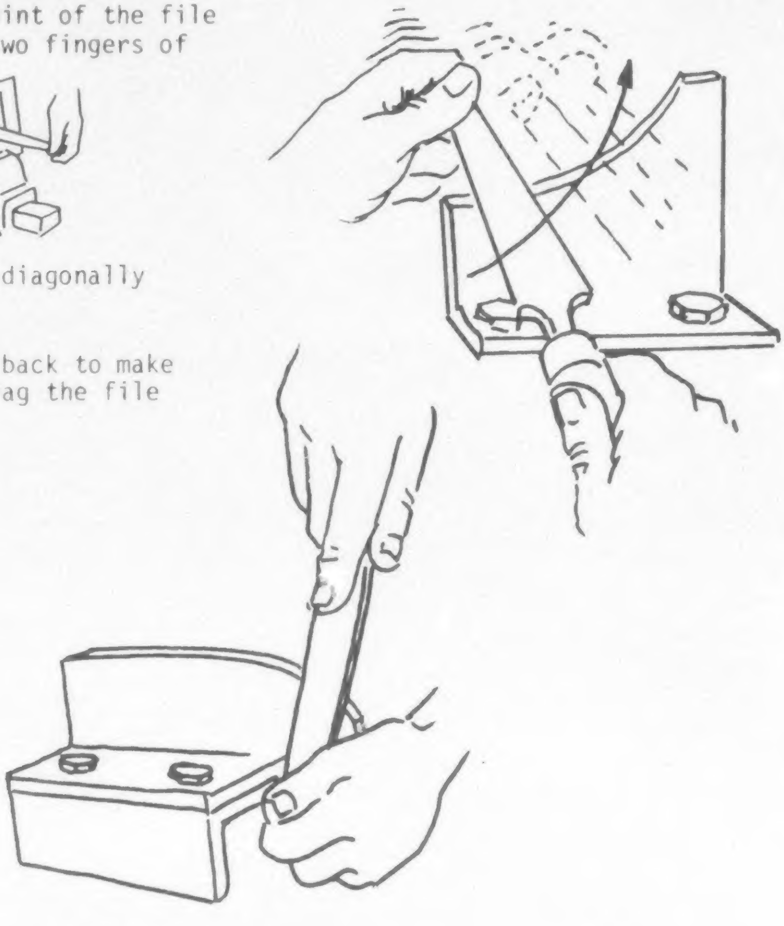


2. Hold the handle of the file in one hand with your index finger stretched out on top the file. Hold the point of the file with the thumb and first two fingers of your other hand.



3. File with forward strokes diagonally across the edge.

4. Lift the file and move it back to make the next stroke. Don't drag the file back across the metal.



OPERATION SHEET
SC-2-46

COMPETENCY: Cutting Metal on the Band Saw

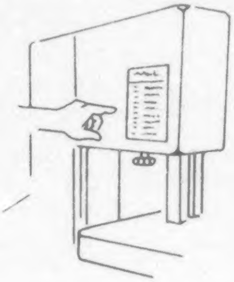
COURSE: Metal Fabrication UNIT II: Fabrication

OBJECTIVE: To operate the band saw in an efficient manner with proper safety

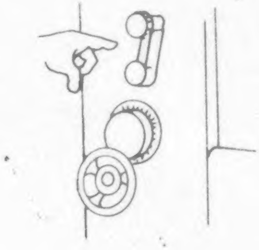
Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

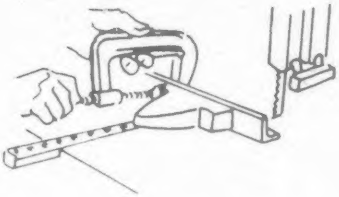
1. Select the proper speed for cutting.



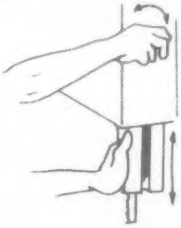
2. Set speed control.



3. Clamp work down properly.



4. Set saw guide for proper height.



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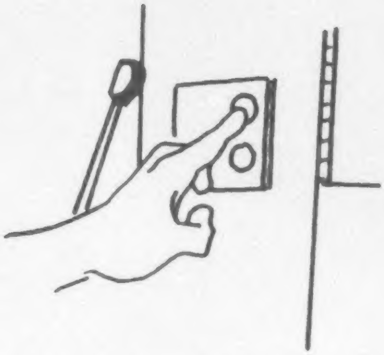
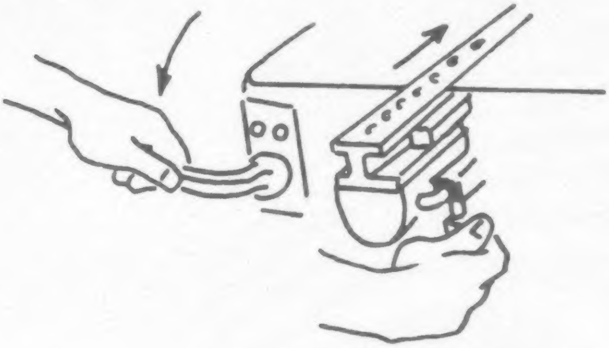
5. Turn on saw.



6. Set speed control for correct feeding speed.

7. Put automatic feed control to forward gear to start the cut.



8. Make cut.

9. Shut off the machine.

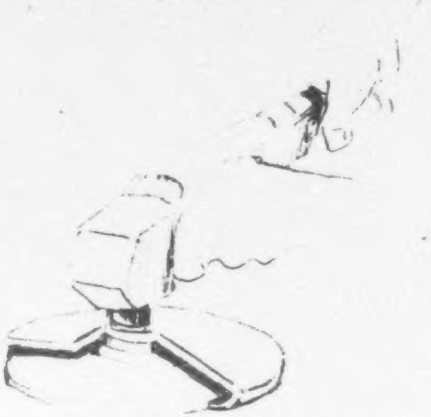
OPERATION SHEET
SC-2-47

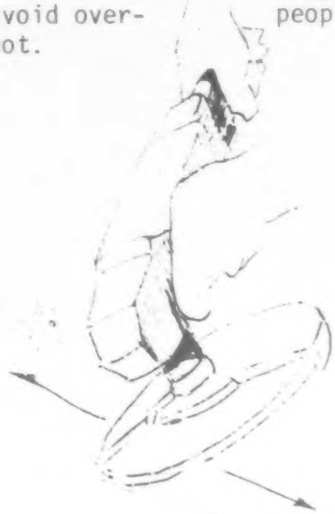
COMPETENCY: Grinding Metal with Depressed Center Wheel

COURSE: Metal Fabricatio   UNIT II: Fabrication

OBJECTIVE: To efficiently and safely grind metal

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Grip grinder firmly in both hands while turning grinder on. (Torque of starting may tear grinder from grip.) 	NOTE: Hold grinder a safe distance from body while turning it on so that if wheel disintegrates the operator is not hurt. Wear eye and face protective mask at all times. Do not drop grinder or jam wheel into work.
2. Hold grinder so that the flat face of the disc comes into contact with workpiece.	NOTE: Sparks that are thrown off the disc should be directed away from operator or other people.
3. Keep grinder in motion to avoid overheating or gouging out a spot.	



OPERATION SHEET
SC-2-48

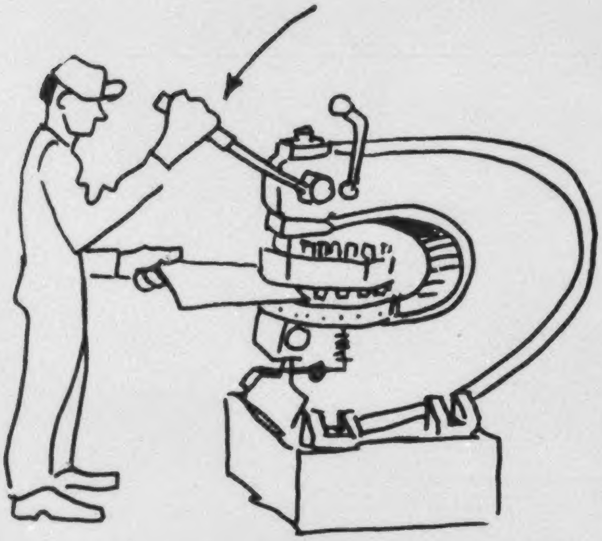
COMPETENCY: Punching Holes in Metal on Turret Punch

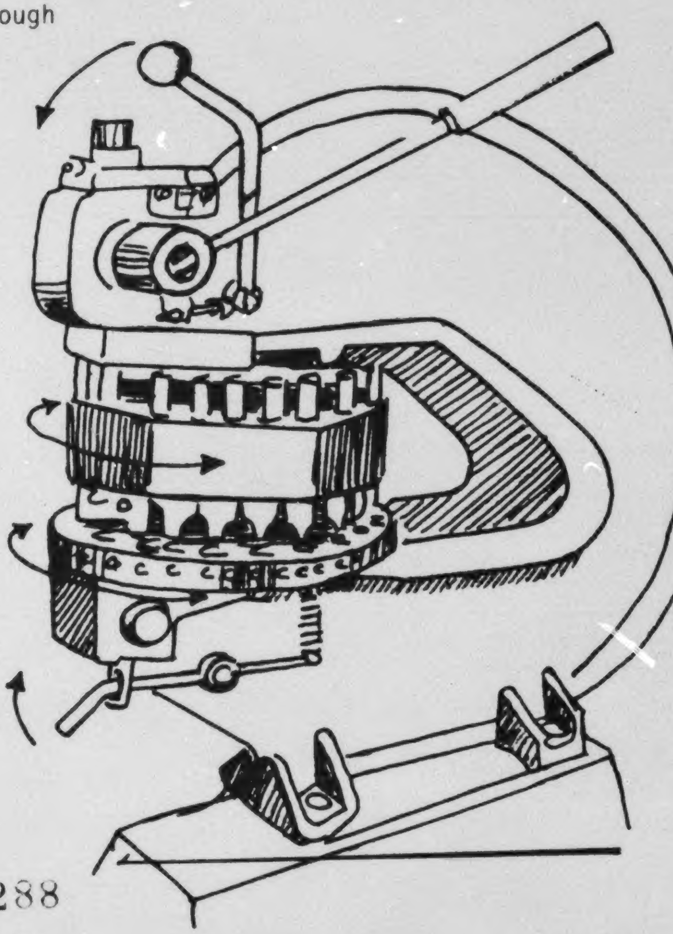
COURSE: Metal Fabrication UNIT II: Fabrication

OBJECTIVE: To punch holes with turret punch rapidly with utmost safety and without damage to machine

Page 1 of 1 page

COMPETENCY - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Pull top handle forward and index top turret to desired size.	
2. Pull bottom handle up and index bottom turret to same size as top punch.	NOTE: Some models have single level control for top and bottom turret.
3. Insert metal as shown.	
4. Pull handle down until prick mark can be aligned with punch.	
5. After alignment pull handle through until hole is punched.	
6. Raise handle. Remove metal.	





OPERATION SHEET
SC-2-49

COMPETENCY: Using the Portable Disc Sander

COURSE: Metal Fabrication   **UNIT II:** Fabrication

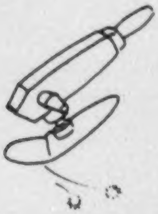
OBJECTIVE: To sand with portable sander without excessive wear on sanding disc and with safety

Page 1 of 2 pages

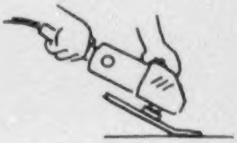
COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

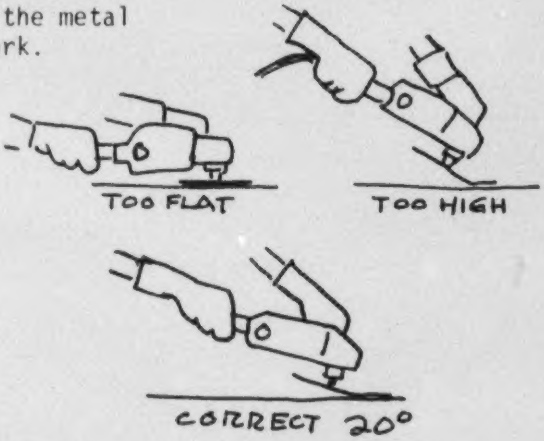
To use the grinder:

1. Hold it so that only the top or bottom 1½" to 2" of the disc will touch the metal.



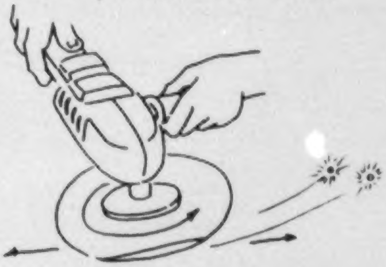
2. Hold the grinder so the side of the disc which is not touching the metal is at a 20° angle to the work.





3. Do not push on the grinder.

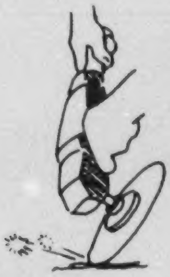
4. Move the grinder back and forth. Overlap about half of each stroke. This leaves a criss cross pattern and shows the low spots.



COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES

The disc grinder can be used to clean metal for brazing, soldering, and plastic filling. By tilting the grinder, you can grind sharp, low areas clean. The grinder must be used carefully and correctly or too much metal may be ground away.

1. Hold the disc at an 80° angle so the edge of the disc will cut into the low spots and welds to clean them out.



OPERATION SHEET
SC-2-50

COMPETENCY: Shearing Metal with the Unishear

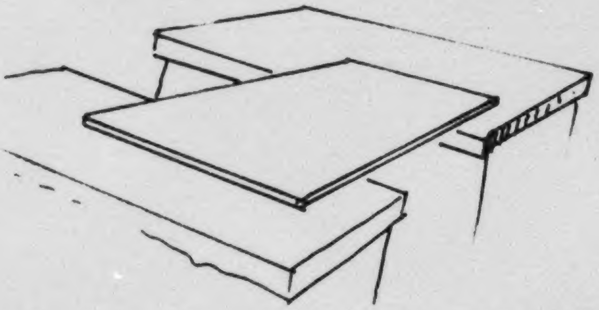
COURSE: Metal Fabrication UNIT II: Fabrication

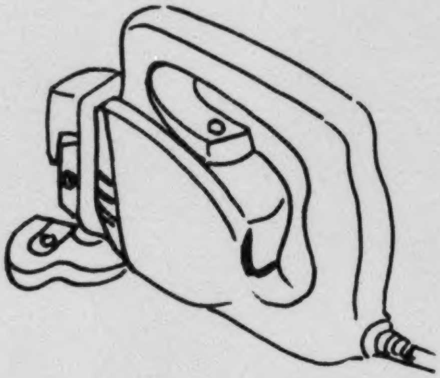
OBJECTIVE: To properly adjust and guide the unishear to make a good clean cut

Page 1 of 2 pages

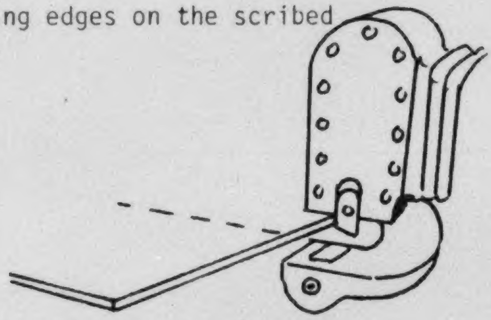
COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

1. Adjust the cutting blades to the proper setting. (This is regulated by the metal thickness you are cutting.)

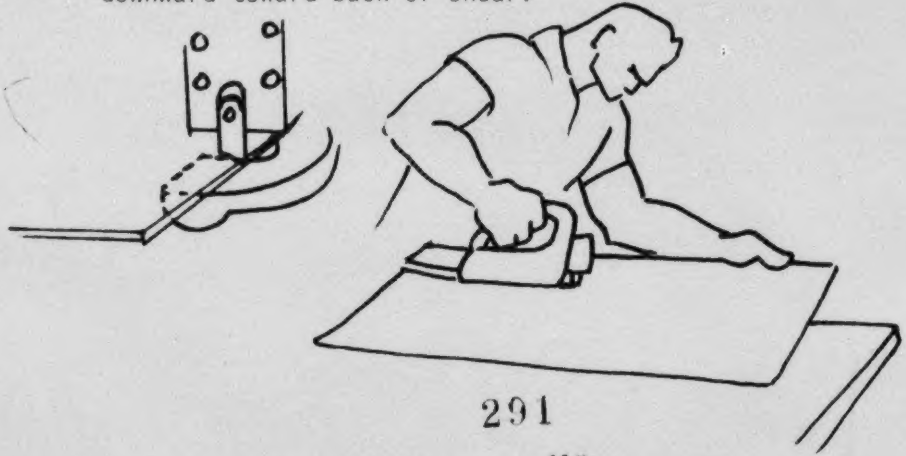




2. Place the cutting edges on the scribed line to be cut.



3. Start the cutter and with a slow steady forward motion, move the unishear blades along the scribed line, apply pressure downward toward back of shear.



COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
4. Stop the unishears and check the portion you have slit or cut.	NOTE: There should be no rough or jagged edges, if there are, readjust the blades so they are closer together.
5. Continue cutting until the entire project is cut.	CAUTION: Do not try to cut through bolts, screws or rivets, it will ruin the cutting edges of the blades.

OPERATION SHEET
SC-2-51

COMPETENCY: Nibbling with Metal Worker

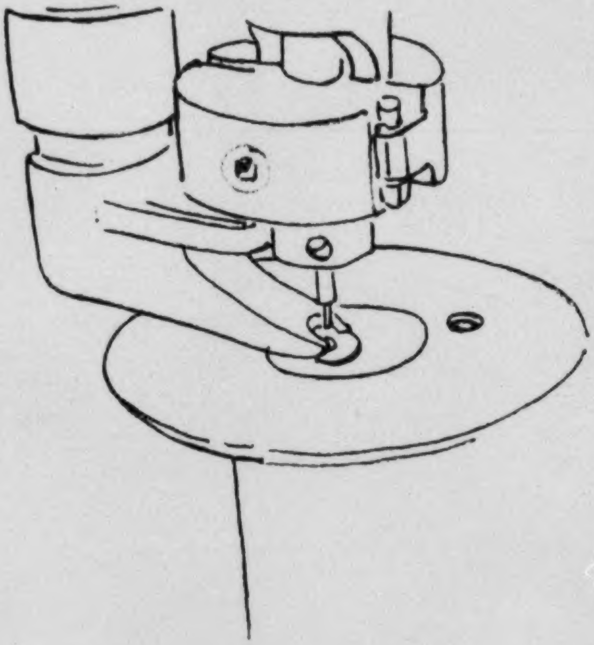
COURSE: Metal Fabrication **UNIT II:** Fabrication

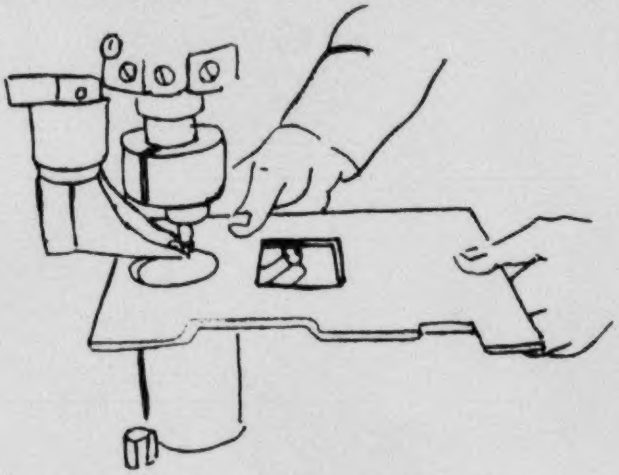
OBJECTIVE: To learn how to cut forms or shapes by power nibbling

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

1. Check setting adjustments on hollow punch and die assembly.
2. Dial proper speed setting for nibbling.
3. Place material into position and clamp securely.
4. Start the machine and open oil line slightly.
5. Turn dial adjuster until punch has cut its way completely through metal.





6. Raise guide pin until it enters the hollow die to its proper depth.
7. Push or pull on the guide bar handle. This causes the punch to do its cutting.

NOTE: Pressure foot should not be down tight on the metal.

SAFETY PRECAUTIONS: Wear gloves and safety goggles.

OPERATION SHEET
SC-2-52

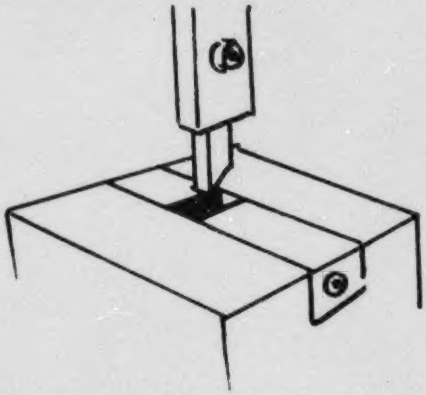
COMPETENCY: Slotting with the Metal Worker

COURSE: Metal Fabrication   **UNIT II:** Fabrication

OBJECTIVE: To properly slot with the metal worker

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Set up slotting tool and adjust to proper slot width.	SAFETY PRECAUTION: Wear gloves and safety glasses.



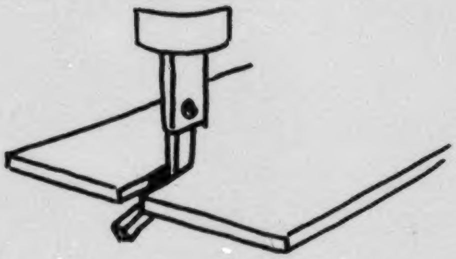
2. Set speed gage to slotting speeds.

3. Place material into guide bar and clamp securely.

4. Start the machine and open oil line slightly.

5. Turn dial adjuster until top cutter goes half way through material to be slotted.

6. Use steady pressure on the feed bar handle forcing the metal into the cutter causing it to be cut or slotted.



NOTE: Cuts should be burr-free, with little or no distortion.

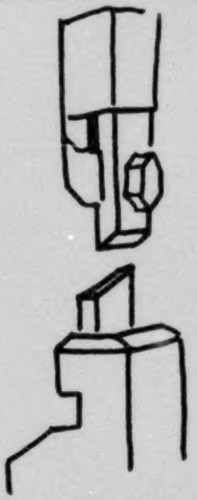
OPERATION SHEET
SC-2-53

COMPETENCY: Shearing with the Metal Worker

COURSE: Metal Fabrication UNIT II: Fabrication

OBJECTIVE: To learn the technique of shearing metal to various sizes and shapes

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Install both bottom and top shearing blades into their proper holders. 2. Adjust cutting edges to material being sheared. 3. Turn speed adjustment dial to shearing. 4. Place material to be sheared into position and clamp securely. 5. Start the machine. 6. Use pressure on guide handle to shear the metal. 7. Do not over or force feed.	 NOTE: Shearing does not waste or nibble away any metal. It acts the same as cutting with a pair of hand shears. SAFETY PRECAUTIONS: Wear gloves and safety goggles.

OPERATION SHEET
SC-2-54

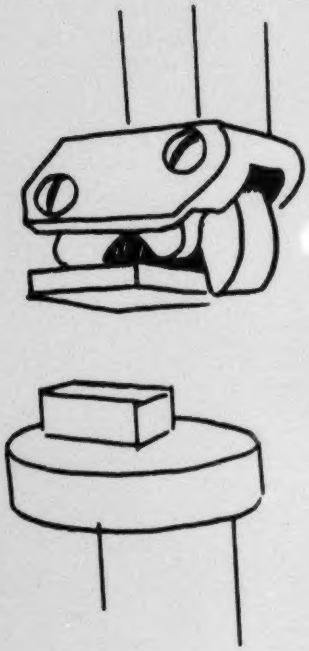
COMPETENCY: Flanging with the Metal Worker

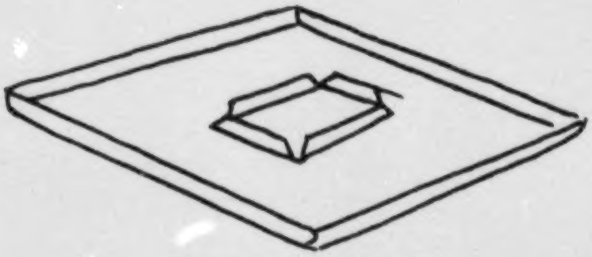
COURSE: Metal Fabrication UNIT II: Fabrication

OBJECTIVE: To learn the technique of internal and external flanging

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Place bottom and top flanging attachments into their proper place and secure.	
2. Check height and flanging clearance adjustments.	NOTE: They should be set to metal working thickness.
3. Adjust machine speed to (Flanging).	
4. Place the metal into position.	
5. Start the machine.	
6. Adjust depth of stroke so it does not make the complete flange on the first pass.	
7. Run material completely through flanger.	
8. Readjust flanging depth and proceed to put metal through again until flange is completed to the degree you desire.	





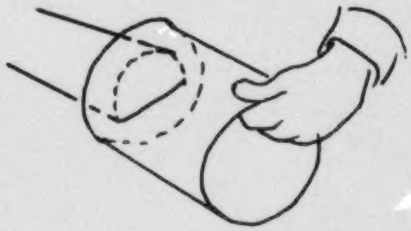
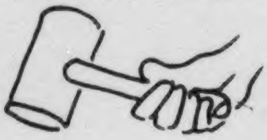
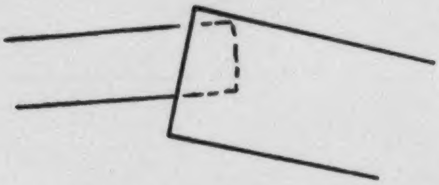
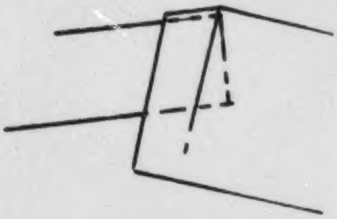
OPERATION SHEET
SC-2-55

COMPETENCY: Shrinking Metal Cold

COURSE: Metal Fabrication — UNIT II: Fabrication

OBJECTIVE: To properly shrink metal in its natural or cold state

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Mark the width of the flange on the outside of the job with a marking gage.	
2. Place the conductor stake or hollow mandrel securely in the bench plate.	
3. Hold the job with the end to be shrunk on the end of the stake. 	
4. Strike the edge to be shrunk with a mallet.	NOTE: Not a steel hammer.  
5. Revolve the job while striking with the mallet until entire edge to be shrunk has been started.	
6. As the metal shrinks,lower the job on the stake and keep striking the edge until required finish is obtained.	

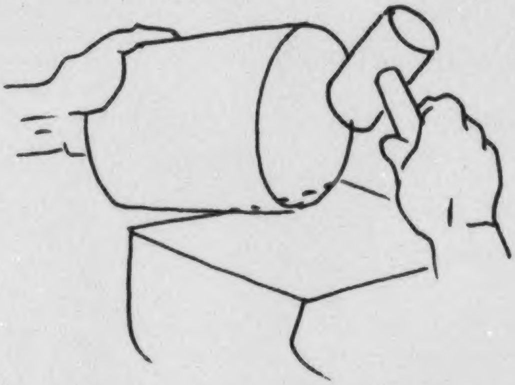
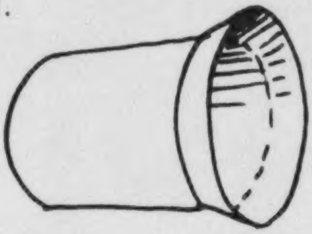
OPERATION SHEET
SC-2-56

COMPETENCY: Stretching Metal Cold

COURSE: Metal Fabrication **UNIT II:** Fabrication

OBJECTIVE: To flange or stretch an edge on a stake

Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Mark the width of the flange on the inside of the job with a marking gage.	
2. Place the square stake in a hole in the bench plate.	
3. Hold the job with the edge to be flanged on the stake as shown. 	
4. Strike the edge with the peen end of a riveting hammer.	NOTE: A hammer not a mallet, and it must be blunt or round.
5. While striking revolve the piece until entire edge to be stretched has been started. 	
6. Lower the job as the metal stretches and keep striking the job with the peen of the hammer until required angle is obtained.	

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COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
7. Place the conductor stake in the bench plate hole.	
8. Hold flange on surface of stake and with face of hammer smooth out the flange.	

OPERATION SHEET
SC-3-1

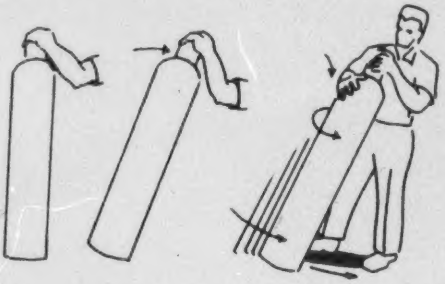
COMPETENCY: Transporting Acetylene and Oxygen Cylinders

COURSE: Metal Fabrication UNIT III: Welding

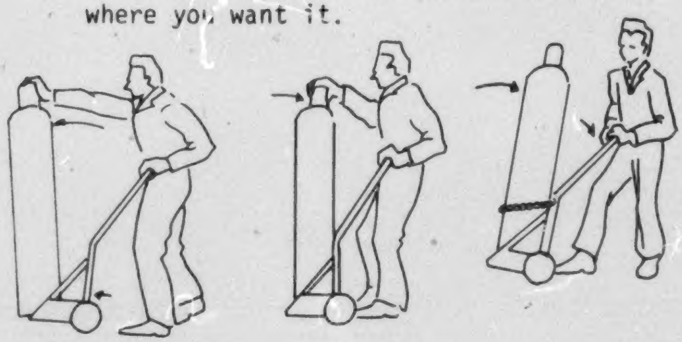
OBJECTIVE: To move cylinders into position safely and without physical injury

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Move the cylinder by holding the valve protection cap in your left hand and tilting the cylinder toward the left. Roll the cylinder with your right hand.	NOTE: Tanks should be stored upright.



COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
2. Rock the cylinder onto the cart and strap or chain it so that it will not upset.	NOTE: Move cylinders on an approved cart.
3. Tilt the cart back and push or pull it where you want it.	CAUTION: Never move an oxygen cylinder without the valve protection cap in place. NOTE: Keep the cylinder away from grease, oil, and open flame.



OPERATION SHEET
SC-3-2

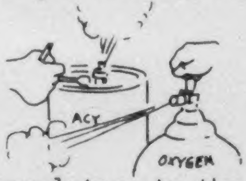
COMPETENCY: Setting Up Gas Welding Equipment

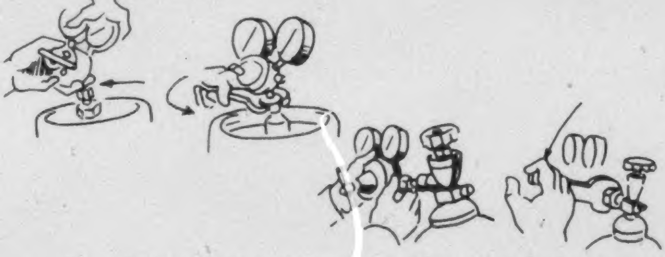
COURSE: Metal Fabrication UNIT III: Welding

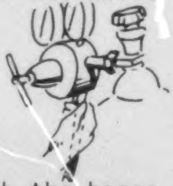
OBJECTIVE: To connect gas welding equipment safely and quickly and without damage to equipment

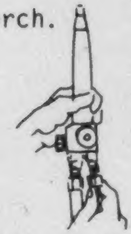
Page 1 of 3 pages

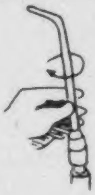
COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Crack open and quickly close the cylinder valves before you connect the regulators.	CAUTION: Never open both tanks at the same time.
2. Attach the regulators to the cylinder nozzles.	NOTE: The oxygen is right-hand threaded and the acetylene is left-hand threaded.
3. Attach the hoses to the regulators.	
4. Attach the hoses to the torch.	
5. Attach the proper tip and mixing head.	





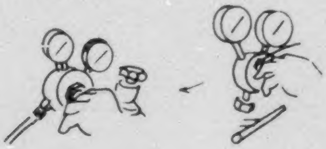




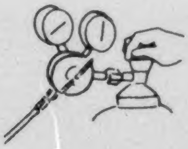


COMPETENCE - PROCEDURE/STEPS

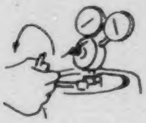
6. Back off the regulator screws on both units until the screws turn freely.



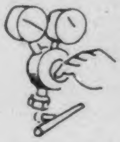
7. Open the oxygen cylinder valve all the way.



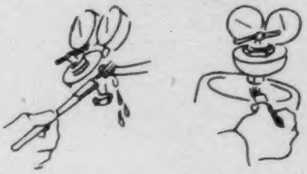
8. Open the acetylene cylinder ¼ to ½ turn counterclockwise.



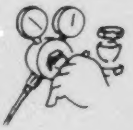
9. Turn the acetylene regulator screw in to adjust the acetylene working pressure.



10. Check the acetylene system with soapy water.



11. Turn the regulator screw on the oxygen in to adjust the working pressure.



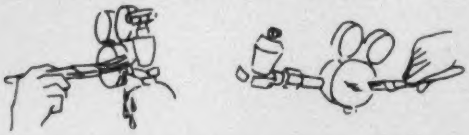
TEACHING/LEARNING ACTIVITIES

NOTE: Be sure both needle valves on the torch are turned off -- clockwise.

NOTE: All oxy-acetylene gages should read no pressure.

COMPETENCE - PROCEDURE/STEPS | TEACHING/LEARNING ACTIVITIES

12. Check the oxygen system with soapy water.



OPERATION SHEET
SC-3-3

COMPETENCY: Opening the Oxy-Acetylene Equipment for Welding

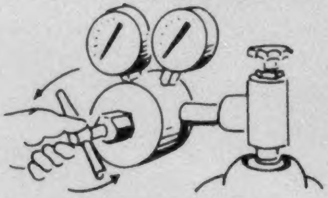
COURSE: Metal Fabrication UNIT III: Welding

OBJECTIVE: To quickly and safely prepare gas welding equipment for use

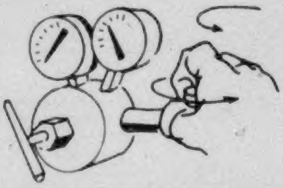
Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

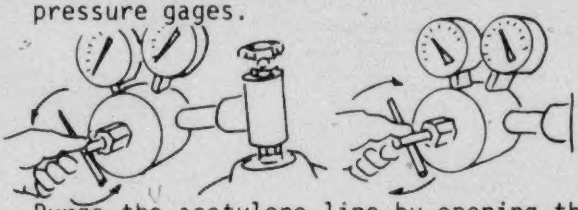
1. Slowly open the acetylene cylinder ¼ to ½ turn.



2. Slowly open the oxygen cylinder valve all the way.



3. Turn the regulator adjusting screws to the proper working pressure on low pressure gages.



4. Purge the acetylene line by opening the acetylene line and then closing it again quickly.

5. Purge the oxygen line by opening the oxygen line and then closing it again quickly.

TEACHING/LEARNING ACTIVITIES

CAUTION: Make sure the regulator adjusting screws are turned out (counter clockwise) until they are free of pressure and that the torch valves are closed.

OPERATION SHEET
SC-3-4

COMPETENCY: Lighting and Adjusting the Torch and Flame

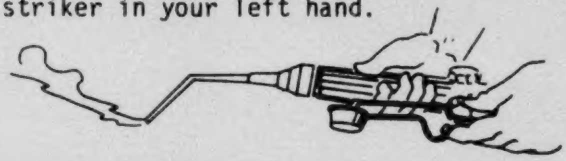
COURSE: Metal Fabrication UNIT III: Welding

OBJECTIVE: To light and adjust torch for efficiency and safe operation

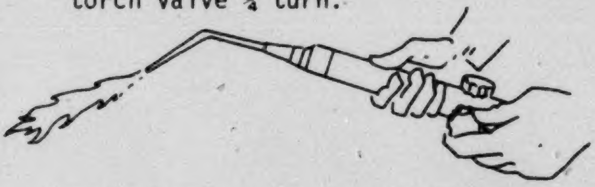
Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

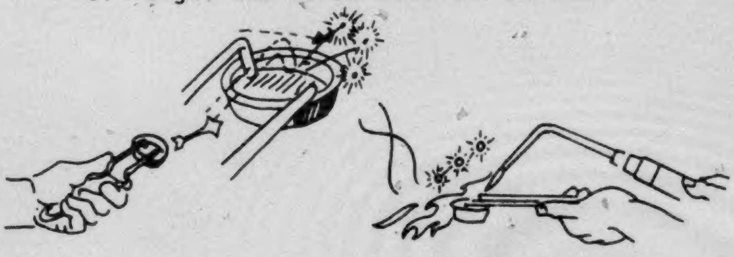
1. Hold the torch in your right hand and the striker in your left hand.



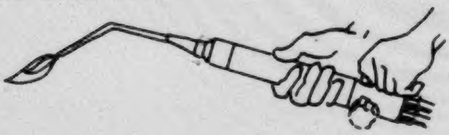
2. With your left hand, open the acetylene torch valve ¼ turn.

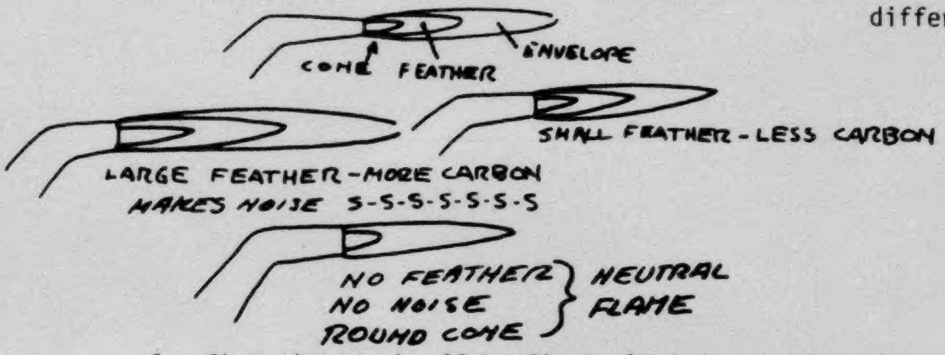


3. Light the torch with the striker.



4. Adjust the acetylene flame with the torch valve until the flame is between smoke and blow off.



COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
5. Open the oxygen valve and adjust it to the proper flame.  CONE FEATHER ENVELOPE SMALL FEATHER - LESS CARBON LARGE FEATHER - MORE CARBON MAKES NOISE S-S-S-S-S-S-S NO FEATHER NO NOISE ROUND CONE NEUTRAL FLAME	NOTE: Neutralizing, oxidizing, and carburizing flames are different.
6. Shut the torch off by first closing the acetylene torch valve.	
7. Close the oxygen valve.	

OPERATION SHEET
SC-3-5

COMPETENCY: Closing the Oxy-Acetylene Equipment

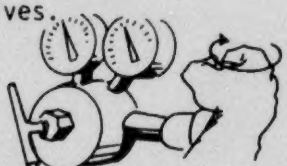
COURSE: Metal Fabrication **UNIT III:** Welding

OBJECTIVE: To safely close down oxy-acetylene equipment

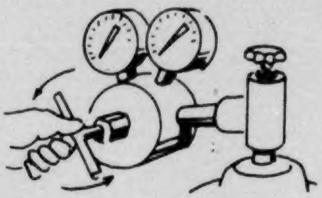
Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

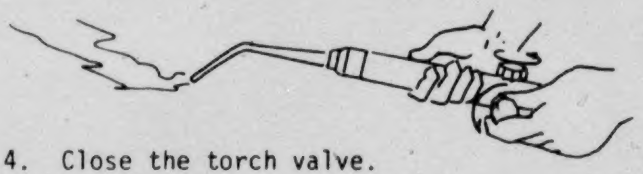
1. Close the cylinder valves.



2. Open the torch valves and drain the hose.



3. Unscrew the regulator pressure keys.



4. Close the torch valve.

5. Put the hose and torch in their proper places.

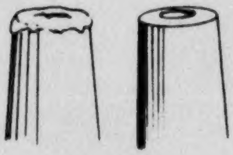
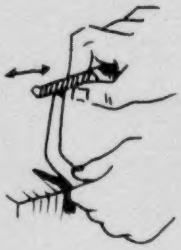
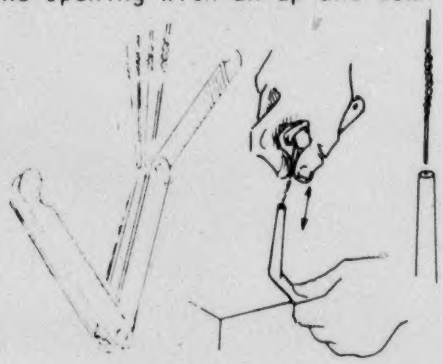
OPERATION SHEET
SC-3-6

COMPETENCY: Cleaning Cutting or Welding Tips with a Tip Cleaner

COURSE: Metal Fabrication UNIT III: Welding

OBJECTIVE: To clean welding tips for best results without damage to torch tips

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. File the tip edges and face to remove all particles of slag and to bring the tip back to shape.  	
2. Hold the selected cleaner firmly and clean the opening with an up and down motion. 	NOTE: Never ram, twist or turn the cleaner. For a proper tip core the cleaner must float freely.

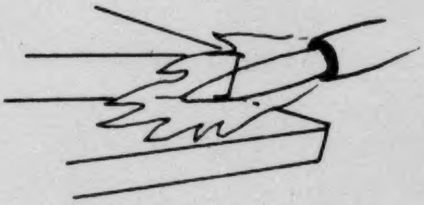
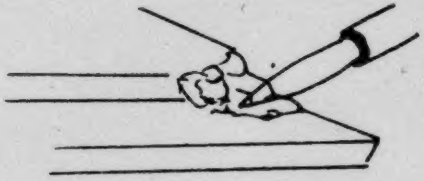
OPERATION SHEET
SC-3-7

COMPETENCY: Joining Metal by Fusion Welding without Filler Rod

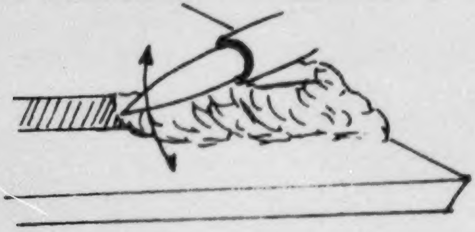
COURSE: Metal Fabrication **UNIT III:** Welding

OBJECTIVE: To join metal, by forming puddles and fusion welding, with a torch

Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Put the metal on a bench covered with fire bricks.	
2. Hold the torch at a 45° angle, and, beginning at the right side of the plate, melt the two pieces of metal together--tack weld. 	
3. Holding the torch at a 45° angle from the direction of travel, melt the base metals and work flame across melted metal until they fuse together. 	

4. Holding the torch at 45° traveling from right to left, forehand technique, melt the base metal to form a puddle.



5. Moving the puddle right to left, keep the right bead size.

OPERATION SHEET
SC-3-8

COMPETENCY: Joining Metal by Fusion Welding with Filler Rod

COURSE: Metal Fabrication **UNIT III:** Welding

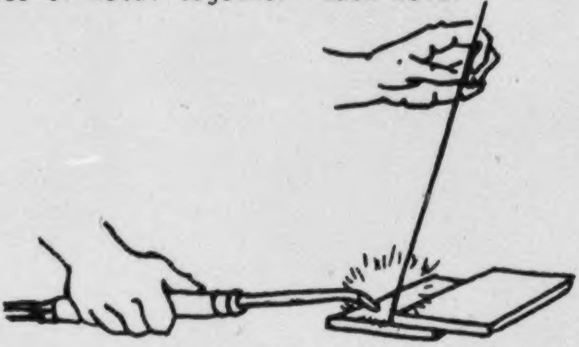
OBJECTIVE: To join metal by adding filler rod to puddle

Page 1 of 2 pages

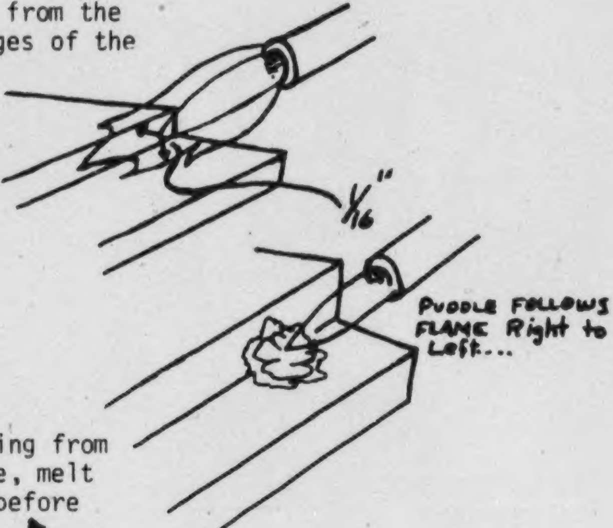
COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

1. Put the metal on a bench covered with firebricks.

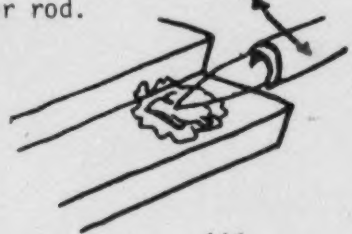
2. Hold the torch at a 45° angle, and, beginning at the right side of the plate, melt the two pieces of metal together--tack weld.



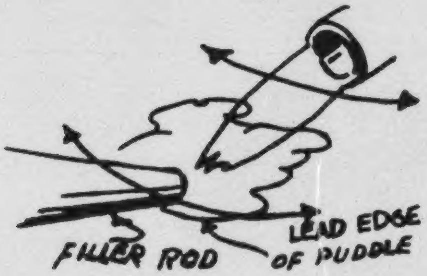
3. Holding the torch at a 45° angle from the direction of travel, melt the edges of the left side--tack weld.



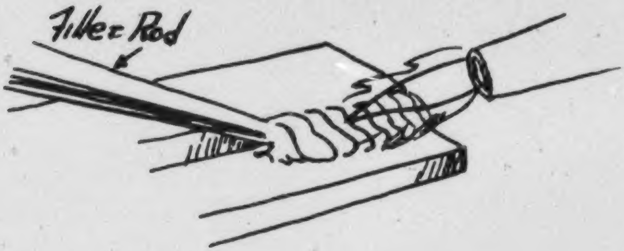
4. Holding the torch at 45°, traveling from right to left, forehand technique, melt the base metal to form a puddle before you add the filler rod.



5. Place the filler rod in the leading edge of the puddle at a 45° angle, 1/16" from the cone of the flame.


LEAD EDGE OF PUDDLE
FILLER ROD

6. Moving the puddle right to left, add enough filler to keep the right bead size.



312

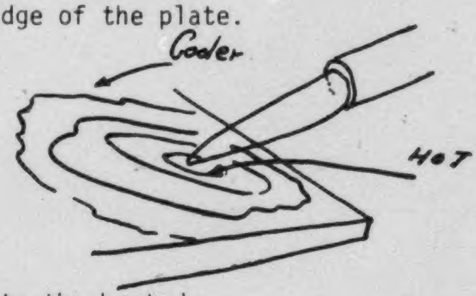
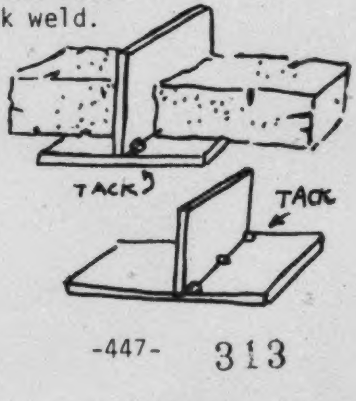
OPERATION SHEET
SC-3-9

COMPETENCY: Brazing

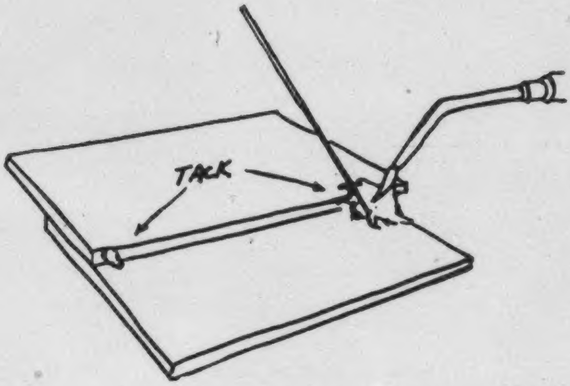
COURSE: Metal Fabrication **UNIT III:** Welding

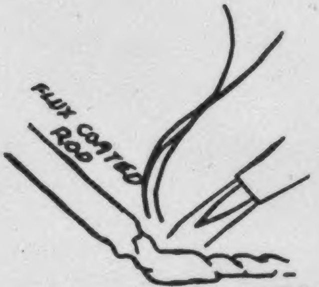
OBJECTIVE: To join metal by hand soldering with brass rod

Page 1 of 2 pages

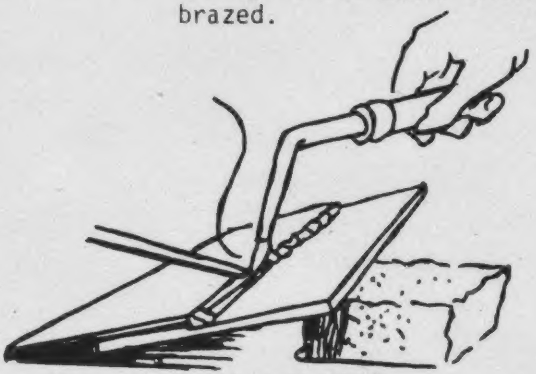
COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Place the metal on a bench covered with fire bricks.	
2. Heat the end of the brazing rod and dip it into flux.	NOTE: Skip this step if you are using a flux coated rod.
3. Hold the torch at a 45° angle and preheat the base metal to dull red on the right edge of the plate.  	
4. Touch the rod to the heated portion and let it melt and react with the base metal--tack weld.  	

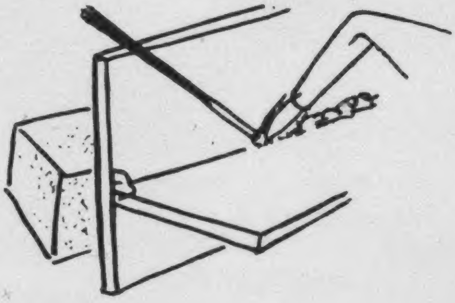
5. Repeat step 4 on the left edge to finish tacking the plate.




FLUX COATED ROD
FLUX MUST COVER MOLTEN METAL

6. Hold the torch at a 45° angle and reheat the right edge of the plate to dull red. Weave the rod and flame in a steady motion until entire joint is brazed.


BLOCK UP WITH BRICK



OPERATION SHEET
SC-3-10

COMPETENCY: Lighting and Adjusting the Prestolite Torch

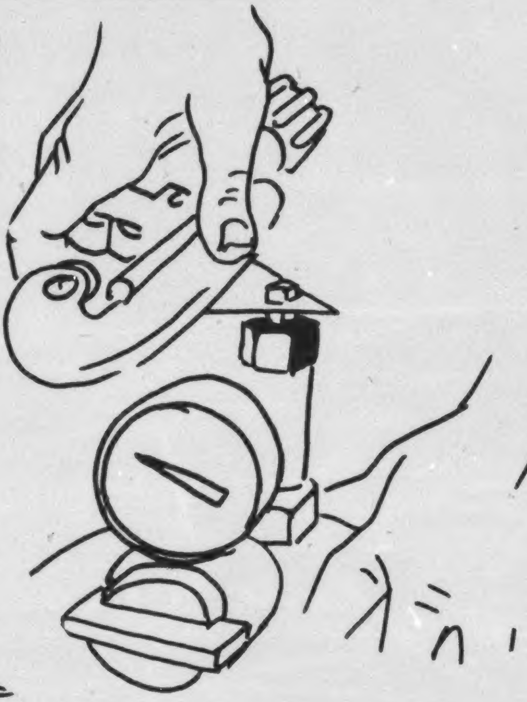
COURSE: Metal Fabrication UNIT II: Fabrication

OBJECTIVE: To safely and efficiently use the prestolite torch

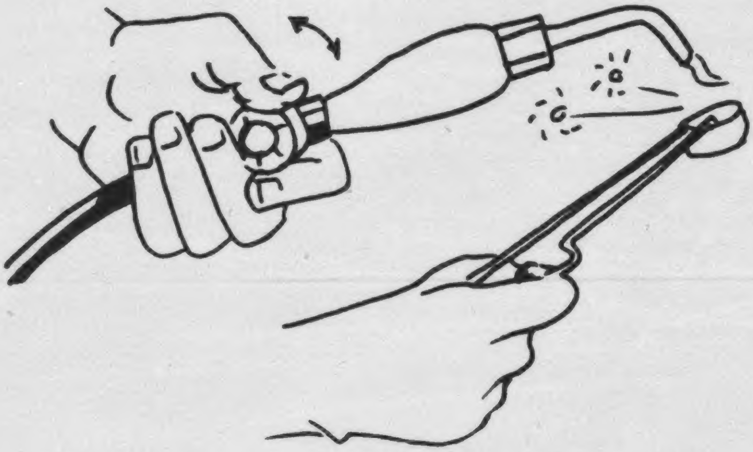
Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

1. Insert the tank key on the tank valve and open the tank so gas can go through regulator into hoses. (Let key on tank valve.)



2. Open the gas valve on the torch handle, approximately 1/4 to 1/2 turn.
3. Hold torch tip away from you.
4. Use friction lighter and strike in front of torch tip.



5. As soon as torch lights, open valve on torch handle to full flame. If flame is large and maintains a blue-green color tank has proper gas. Close valve until you have the flame cone (inner) at approximately 1/4 to 1/2".

CAUTION: Always check hoses, valves and gages for damage or leaks. If any are located, close tank and replace faulty piece with new.

OPERATION SHEET
SC-3-11

COMPETENCY: Attaching and Lighting a Cutting Torch

COURSE: Metal Fabrication UNIT III: Welding

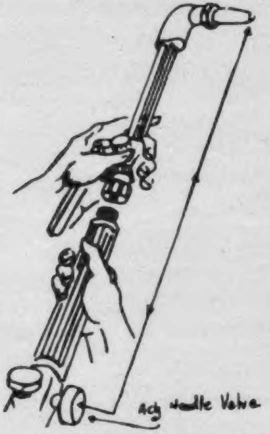
OBJECTIVE: To attach cutting head and light and adjust torch in preparation for flame cutting

Page 1 of 3 pages

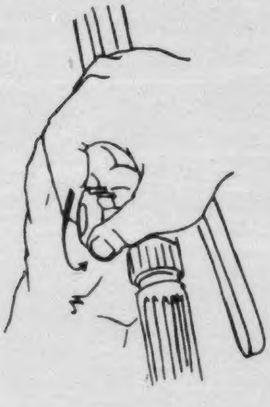
COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

1. Hold the torch in your right hand and the cutting attachment in your left hand.

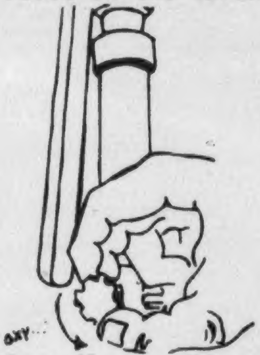
2. Seat the cutting attachment and line the top up with the acetylene needle valve.



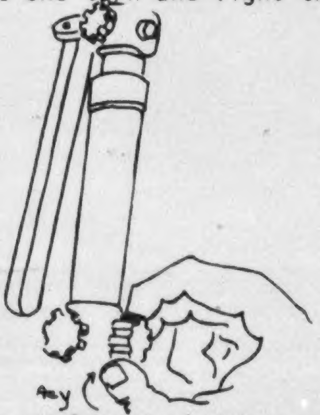
3. Tighten the cutting attachment nut to the torch body hand tight.



4. Turn the oxygen needle valve on the torch handle completely open.

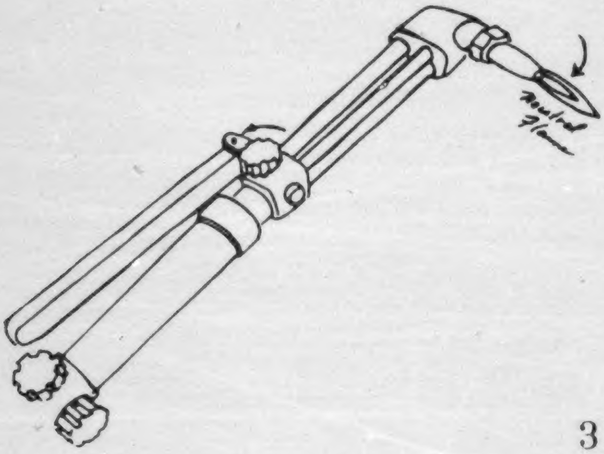


5. Open the acetylene needle valve on the torch handle one turn and light the torch.

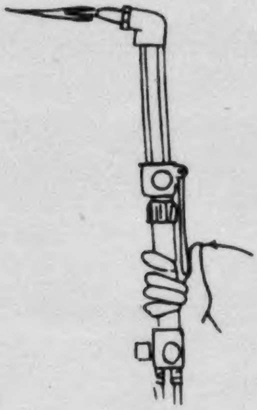


6. Adjust the acetylene to between smoke and blow off.

7. Open the needle valve on the cutting attachment and adjust to neutral flame.



COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
8. Press the cutting lever fully and re-adjust the flame to neutral if necessary.	



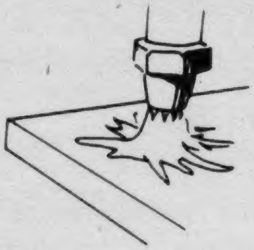
OPERATION SHEET
SC-3-12

COMPETENCY: Flamecutting with a Hand Torch

COURSE: Metal Fabrication UNIT II: Fabrication

OBJECTIVE: To use the torch to flame cut steel

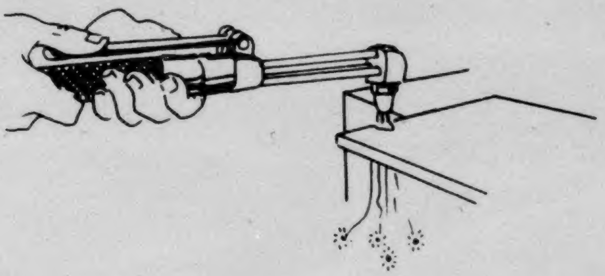
Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Place the metal to be cut so there is room for spark shower clearance under it.	
2. With the torch adjusted to neutral flame, hold the torch handle firmly with your right hand.	NOTE: Start the cut at the edge of the plate when you can.
3. Hold the torch tip vertical to the metal.	
4. Hold the inner cone 1/16" above the surface to be cut. 	
5. Keep the torch in this position until the metal turns bright red.	

COMPETENCE - PROCEDURE/STEPS

TEACHING/LEARNING ACTIVITIES

6. Slowly press the oxygen cutting lever and move the torch along the cutting line.



OPERATION SHEET
SC-3-13

COMPETENCY: Piercing Holes with a Cutting Torch

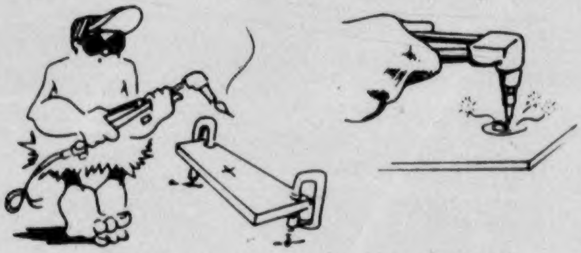
COURSE: Metal Fabrication UNIT III: Welding

OBJECTIVE: To use a cutting torch to pierce holes in steel

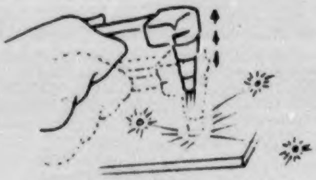
Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

1. Hold the tip about ¼" above the work surface.

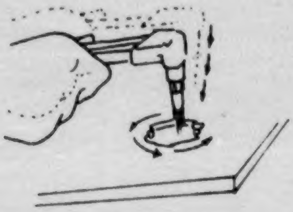


2. Start to raise the tip (½" to 1" above the work). At the same time, slowly press the cutting oxygen lever all the way.



3. Hold the tip steady until a hole is pierced in the metal.

4. Lower the tip to normal height and make sure it is square with the work. Rotate the tip to make the hole as large as you want it to be.



OPERATION SHEET
SC-3-14

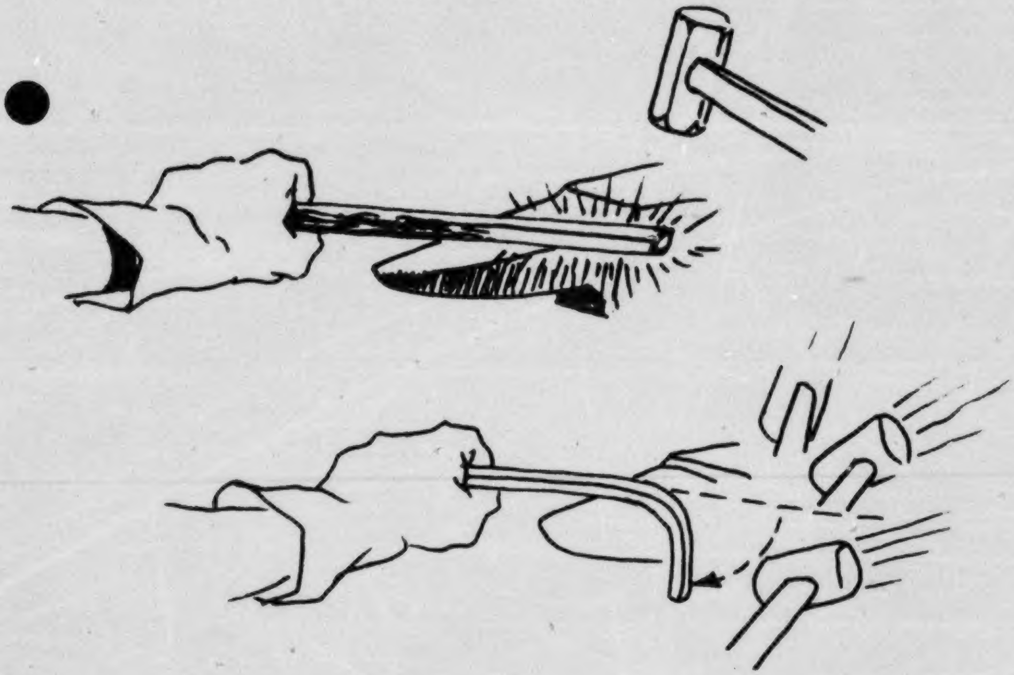
COMPETENCY: Stretching Metal with Heat

COURSE: Metal Fabrication **UNIT III:** Welding

OBJECTIVE: To obtain some knowledge of heat and its effects on metal

Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Hold piece of band iron in left hand using a leather glove.	NOTE: Bend iron is 1/8" x 1" x 24" long.
2. Heat a piece of 1/8" X 1" band iron (with the oxy-acetylene torch) cherry red.	
3. Heat from the opposite end you are holding a distance of 6".	
4. Place over curved horn of anvil and tap with a hammer until you form a 90° bend.	



5. Reheat to red.

6. Place on flut of anvil with the 1" side down on anvil.

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
7. Rework with hammer until band retains its flatness.	
8. Quench in cold water.	NOTE: How the heating and hammering has stretched the outside curve of the metal.

OPERATION SHEET
SC-3-15

COMPETENCY: Shrinking Metal with Heat

COURSE: Metal Fabrication UNIT II: Fabrication

OBJECTIVE: To learn the effects of heat and water on a sheet of metal

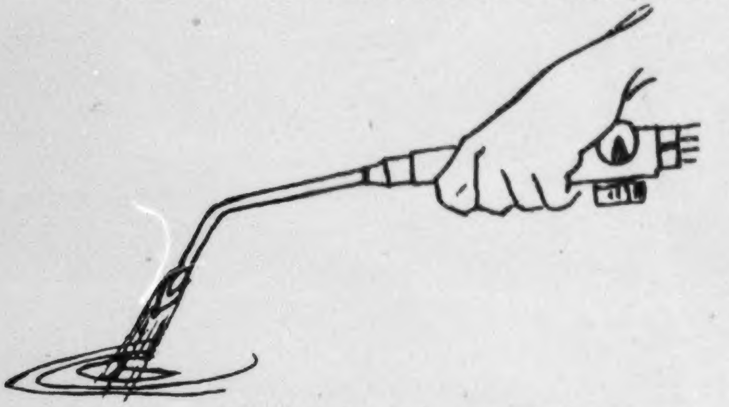
Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

1. Place a piece of 24 gage black metal in vise and stretch with round end of ball peen hammer.

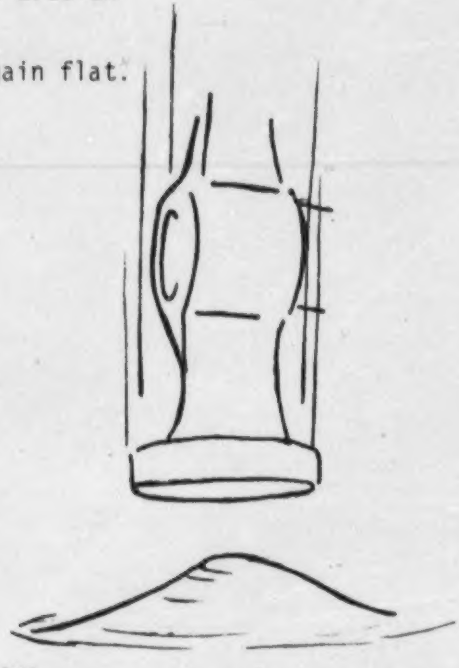
2. Light and adjust torch to a neutral flame.

3. Heat the first stretched area cherry red.

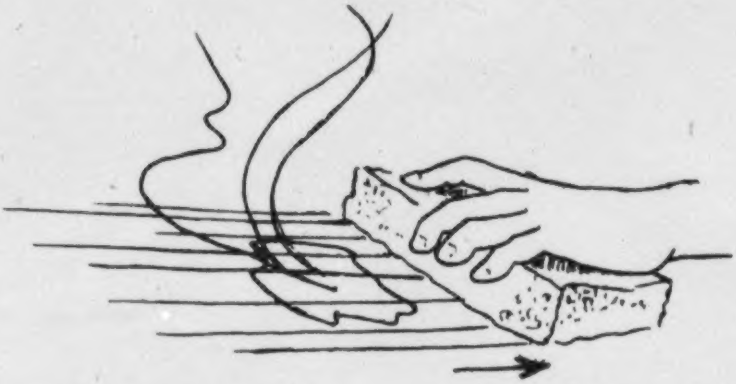


4. Place flat bar behind stretched area on side away from hump or bulge.

5. Hammer lightly until area is again flat.



COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
6. Immediately quench with cold wet sponge.	



7. Repeat procedure on second stretch area.	NOTE: How the heat - light hammering and water has shrunk the metal to its original shape.

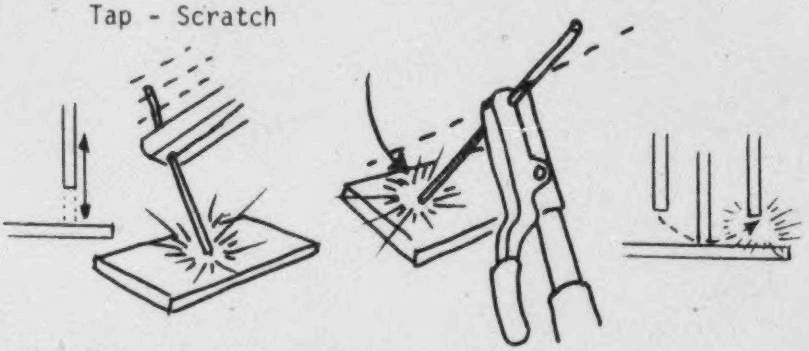
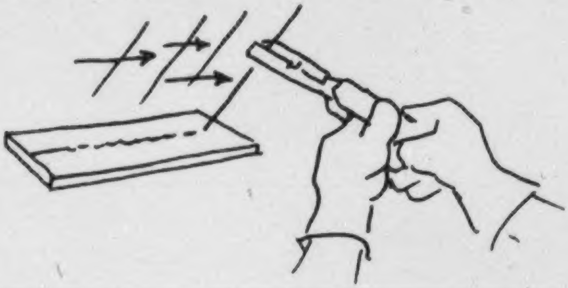
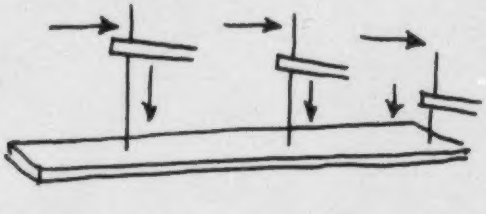
OPERATION SHEET
SC-3-16

COMPETENCY: Strike an Arc and Run a Bead

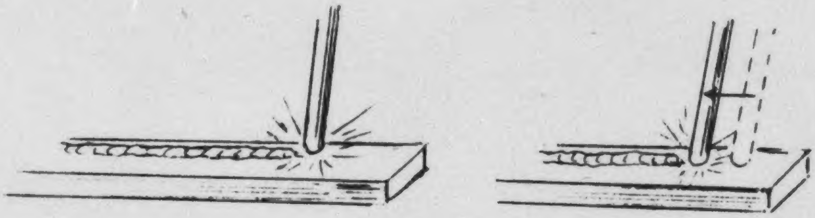
COURSE: Metal Fabrication   UNIT III: Welding

OBJECTIVE: To run smooth, even, properly formed beads with electric welder

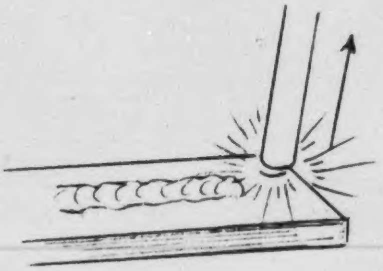
Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Establish the arc on the plane according to method shown: Tap - Scratch 	NOTE: Listen for the arc sound (frying sound).
2. Maintain the arc length and begin to move electrode from left to right. 	
3. As you progress along the plane continually lower rod into puddle as it is consumed. 	
4. Lift rod to stop weld, (break the arc).	

5. To re-start strike arc ahead of puddle (about 1"), maintain long arc to develop heat needed. Move back into puddle and continue on with weld.



6. When weld is completed reverse direction of weld slightly to fill crater - or lift rod slowly allowing crater to fill.



OPERATION SHEET
SC-4-1

COMPETENCY: Using a Caulking Gun

COURSE: Metal Fabrication

UNIT IV: Installation and Repair

OBJECTIVE: To use the caulking gun to apply sealer in an efficient manner

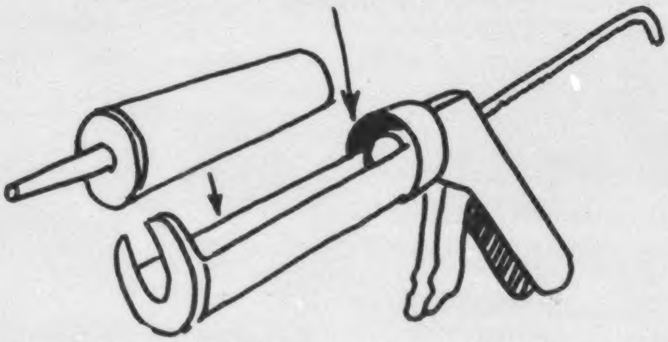
Page 1 of 1 page

COMPETENCE PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

1. Clip off end of caulking tube spout on a slight angle allowing for the size of hole needed.

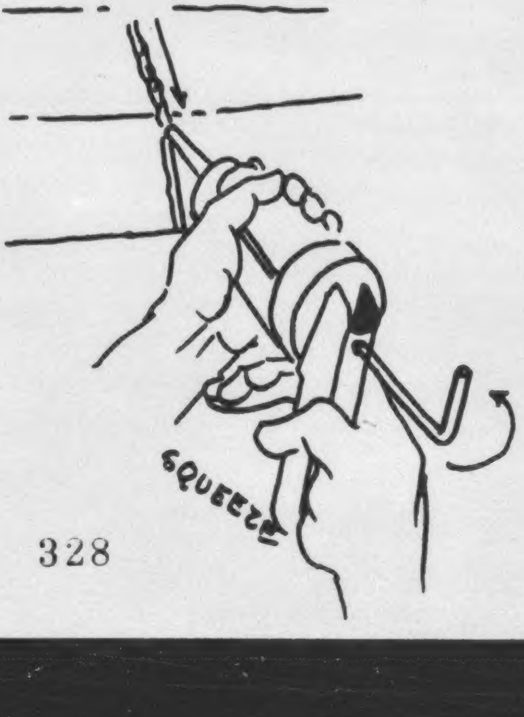
2. Reverse and pull back plunger handle on caulking gun.

3. Insert caulking tube cartridge with back end first into caulking gun.



4. Release caulking gun plunger handle so that the plunger ratchets forward when caulking gun trigger is squeezed.

5. Continue squeezing trigger to produce correct flow of sealer.



6. Release plunger handle when done.

OPERATION SHEET
SC-4-2

COMPETENCY: Leveling

COURSE: Metal Fabrication

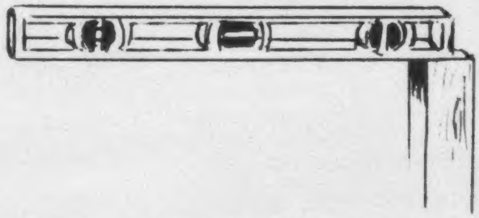
UNIT IV: Installation and Repair

OBJECTIVE: Accurate leveling produces good-looking, first-class jobs.

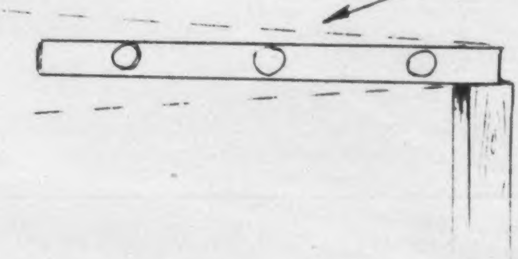
Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

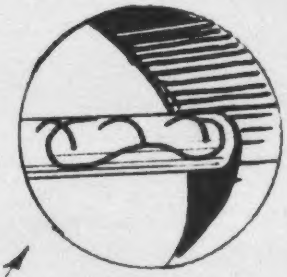
1. Locate point from which you wish to level.
2. Place the end of the level on the point you have established. Hold the one end of the level on that point.



3. Raise or lower the opposite end until the bubble is exactly at level reading.



NOTE: Use only the best and most accurate level. Inaccurate tools are frequent causes of inaccurate work.



NOTE: Some levels have two lines of which the bubble should be centered as shown. Some have one line at which the bubble should be centered as shown.

CAUTION: Do not drop or jar this instrument, it could cause it to become inaccurate.

NOTE: Always use as large a leveling tool as possible. Your reading will always be more accurate.

OPERATION SHEET
SC-4-3

COMPETENCY: Using the Hammer Drill

COURSE: Metal Fabrication

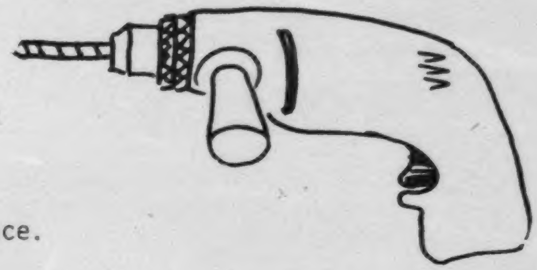
UNIT IV: Installation and Repair

OBJECTIVE: To learn the proper procedures in drilling and hammering with hammer drill

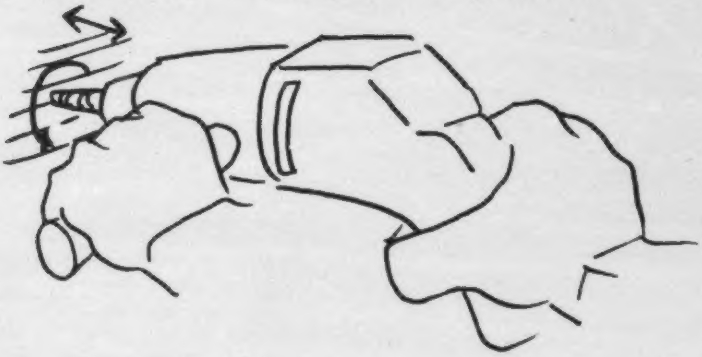
Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

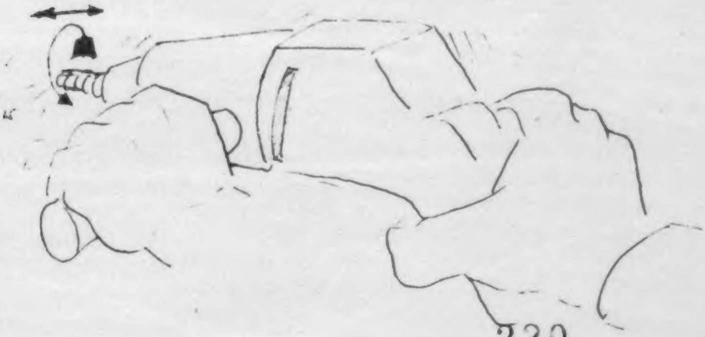
1. Select proper size carbide tipped drill and place into chuck of electric drill.



2. Take hammer and hand star drill and mark location of the hole center.
3. Place the electric drill into position. Use body and arm pressure to hold in place.
4. Push selector button to drill only.
5. Engage on switch and drill hole in masonry approximately 1/2" deep.



6. Push selector button to hammer and drill.
7. Maintain a strong steady pressure on the drill until desired depth of hole is reached.



COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
8. If several holes are to be drilled, set the depth gage so all holes will be drilled the same depth.	

OPERATION SHEET
SC-4-4

COMPETENCY: Using the Water Level

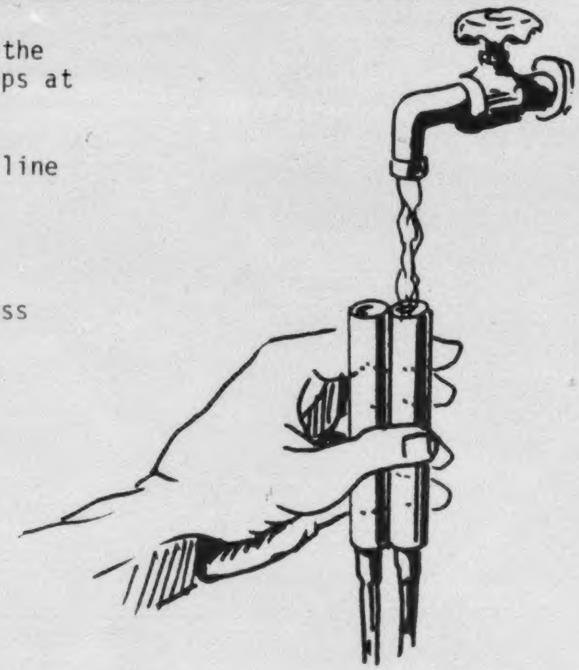
COURSE: Metal Fabrication **UNIT IV:** Installation and Repair

OBJECTIVE: Use of the water level makes it easy to find heights in different areas even though these areas are separated by petitions and walls

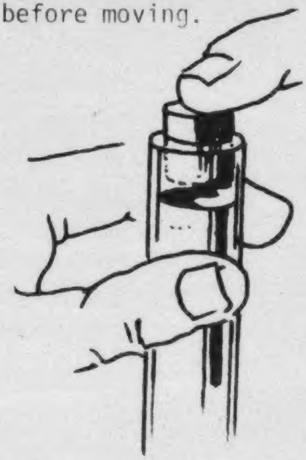
Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

1. Hold the two glass tube ends of the level together in one hand. (Tops at same height)
2. Fill with water until the water line shows half way up the glass.



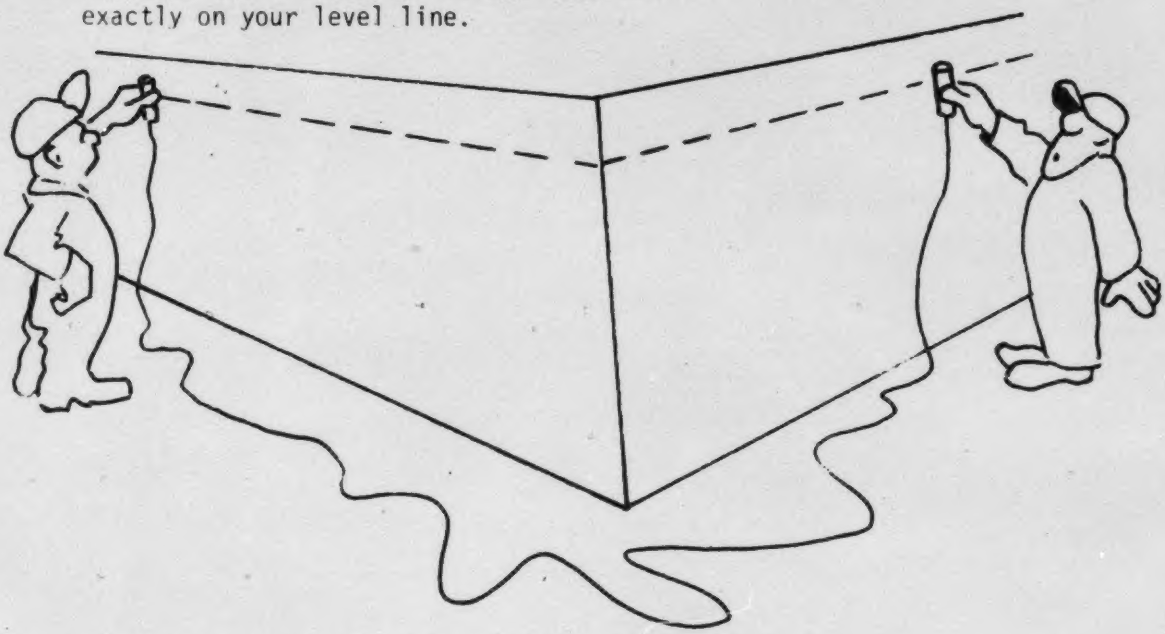
3. Place plugs into top of each glass opening before moving.



4. Keep one glass tube and give the other to your co-worker.
5. Position your tube as near to the level line as you can (Center glass height).
6. Have your co-worker position his tube end as close to level as he can roughly measure or judge.
7. Take out plugs.

COMPETENCE - PROCEDURE/STEPS | TEACHING/LEARNING ACTIVITIES

8. Have your partner slowly raise or lower his tube until the water in the tube is exactly on your level line.



9. Hold steady until all water motion stops.

10. Have your partner mark the exact height of his water line.

11. Proceed to do this in as many places as necessary and then use a chalk line to connect all the points if need be.

OPERATION SHEET
SC-4-5

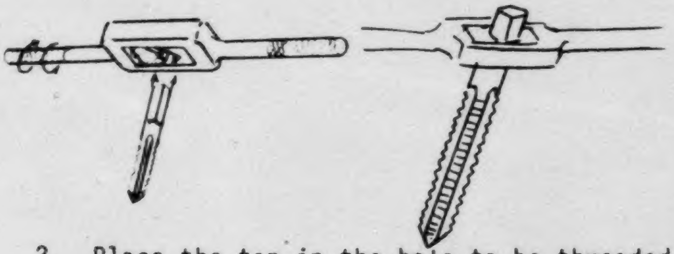
COMPETENCY: Threading Holes with a Tap

COURSE: Metal Fabrication | **UNIT IV:** Installation and Repair

OBJECTIVE: To form internal threads efficiently and without breaking the tips

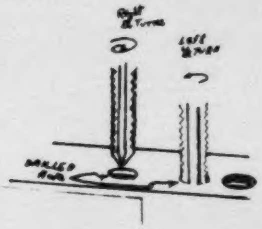
Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Place the tap in the tap handle.	



2. Place the tap in the hole to be threaded.

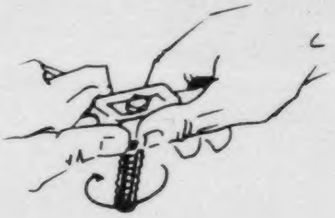
3. Turn the handle clockwise about 2 turns.



4. Turn handle back when it binds.

5. Continue turning and backing until desired depth is reached

NOTE: Use oil while cutting threads.



OPERATION SHEET
SC-4-6

COMPETENCY: Cutting External Threads with a Die

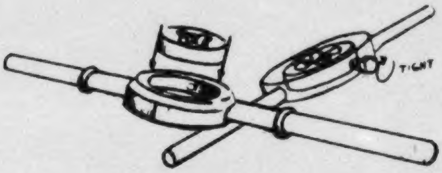
COURSE: Metal Fabrication **UNIT IV:** Installation and Repair

OBJECTIVE: To cut external threads accurately without damage to work piece or die

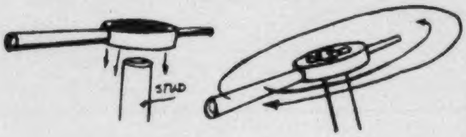
Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

1. Place the bolt or stud in the vise.
2. Place the die in the die holder with the side marked "starting side" facing out.



3. Position the die on top of the bolt or stud. Turn the handle one turn clockwise.
4. Turn the handle back counterclockwise to clean out the threads as they are cut.
5. Drop some cutting oil on the cutting tool.



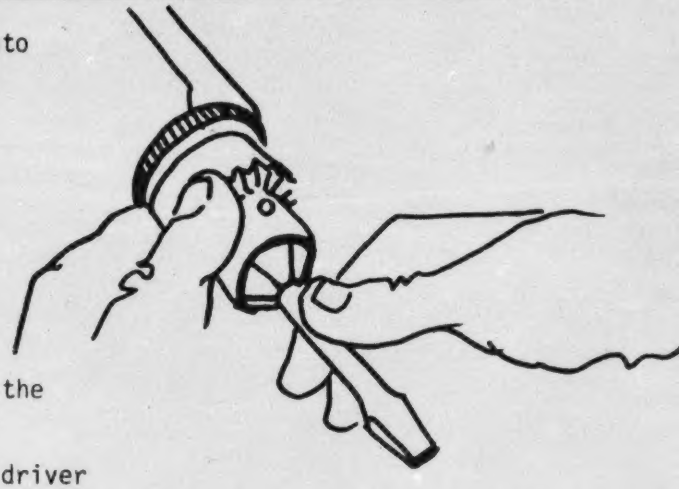
OPERATION SHEET
SC-4-7

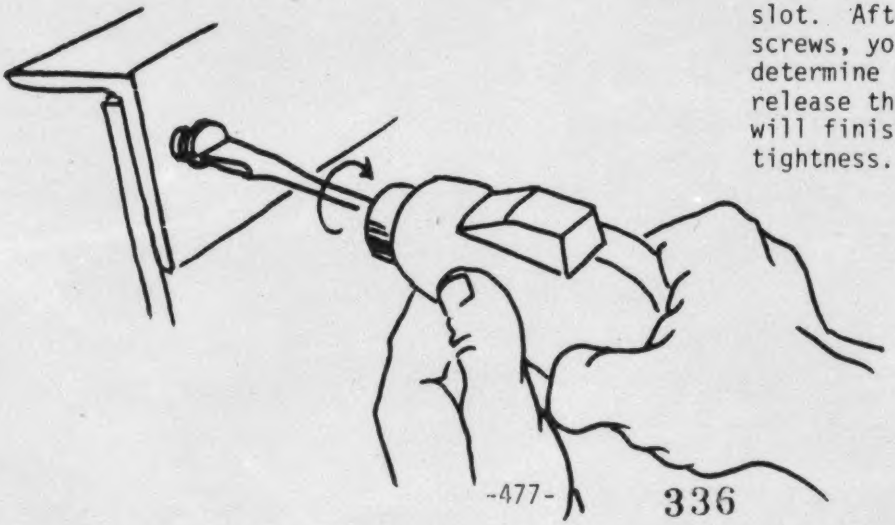
COMPETENCY: Driving a Screw with an Electric Drill

COURSE: Metal Fabrication UNIT IV: Installation and Repair

OBJECTIVE: To obtain the necessary touch and feel of setting screws with a power drill

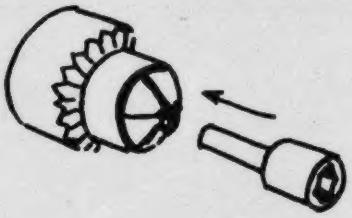
Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Insert screwdriver (flat blade) into drill chuck. Securely tighten.	
2. Place the blade of the driver into the slot of the prestarted screw.	
3. Exert enough pressure on drill and driver to keep tip in slot.	
4. Turn on the drill and run screw in until it is tight.	CAUTION: Do not permit the blade to hop out of the screw slot. After turning in several screws, you should be able to determine the exact time to release the power switch so screw will finish at just the correct tightness.



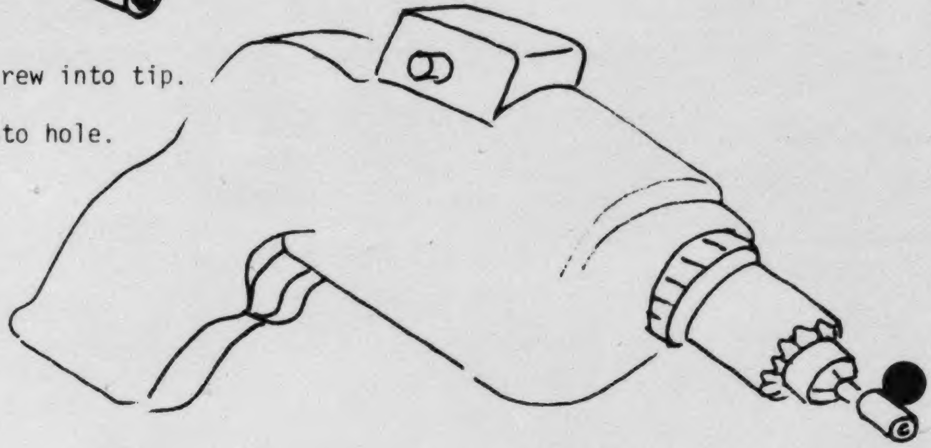
COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES

5. Remove flat blade tip and install magnetic hex tip into drill chuck.



6. Insert hex head screw into tip.

7. Place screw tip into hole.



8. Turn on drill and run screw in until it is tight.

NOTE: These type screws can be installed without a starting or predrilled hole.

OPERATION SHEET
SC-4-8

COMPETENCY: Cutting Metal with Electric Hand Nibbler

COURSE: Metal Fabrication

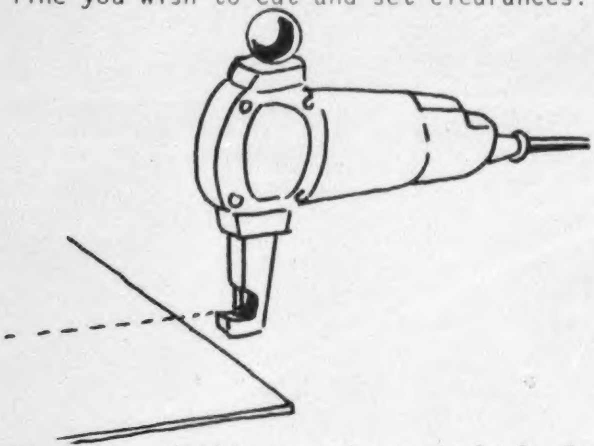
UNIT III: Installation and Repair

OBJECTIVE: To gain a first hand feeling of using the electric nibbler and become familiar with cutting heavy gage material with the nibbling machine

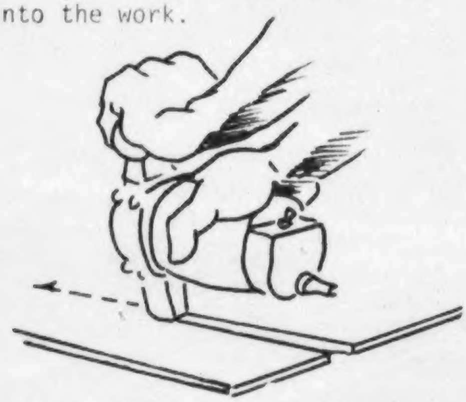
Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

1. Place the metal preferably between two tables or over the edge of one table.
2. Place the cutters of the nibbler on the line you wish to cut and set clearances.



3. Start the nibbling machine and slowly feed the machine into the work.



4. Do not try to go too fast. Feed so the nibbler takes the correct amount of cut.

TEACHING/LEARNING ACTIVITIES

NOTE: Nibbling sheet metal of thicknesses from 1/16" to 1/8" are many times best accomplished by using a heavy duty electric hand (or portable) nibbler since it eliminates the necessity of trying to clear one of the cut portions (either up or down) which is necessary when shearing by hand.

NOTE: If the nibbler is fairly heavy let the sheet of metal carry most of the weight.

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
5. Keep a constant eye on the cutting line and avoid cutting on and off the marks.	
6. Check the cut or nibbled edges, they should be fairly smooth and free of sharp or ragged burrs.	

OPERATION SHEET
SC-4-9

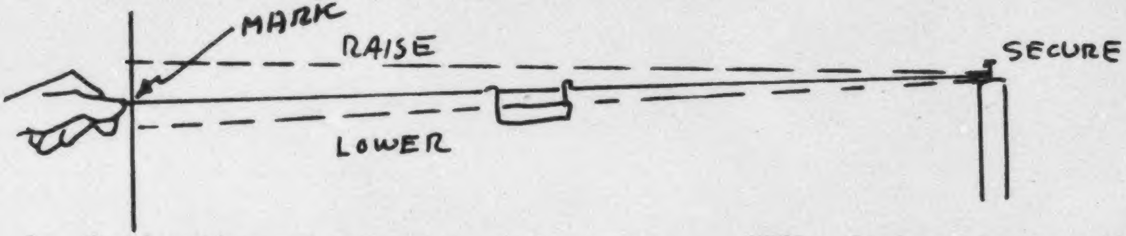
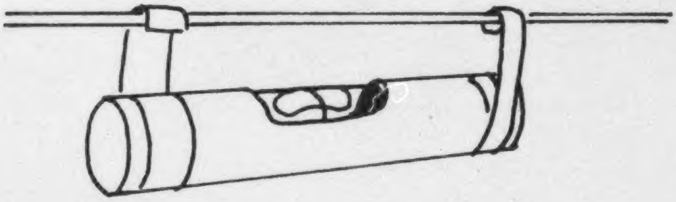
COMPETENCY: Using a Line Level

COURSE: Metal Fabrication

UNIT IV: Installation and Repair

OBJECTIVE: To gain through experience the proper placement of a line level and obtain accurate job results

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Securely fasten one end of your line to a rigid mounting.	
2. Stretch the line very tightly to the point which you wish to mark as level with the unfastened end of the line.	
3. Place the line level exactly in the middle of the stretched line.	NOTE: It is important to place the level in the center to obtain a proper level reading.
4. Raise or lower the end that has not been securely fastened until leveling bubble is exactly on level.	
	
5. Marklocation and proceed in same manner to obtain other level locations.	NOTE: It is much more advantagous to have someone help with this procedure since it speeds up the operation considerably.
	

OPERATION SHEET
SC-4-10

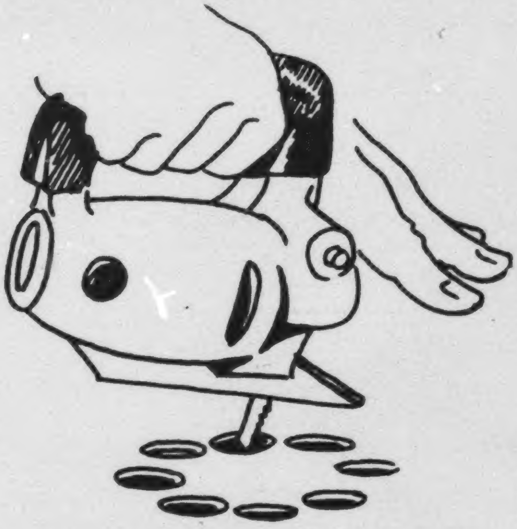
COMPETENCY: Cutting Holes in Metal with Sabre Saw

COURSE: Metal Fabrication UNIT IV: Installation and Repair

OBJECTIVE: To learn how to cut metal decking with the sabre saw

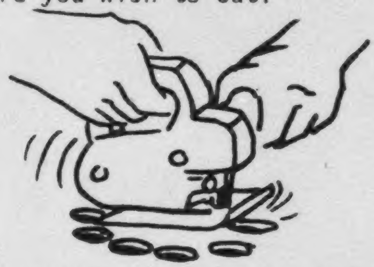
Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Insert saw blade into predrilled holes.	NOTE: Blade should be quite ridged and have approximately 24 to 32 teeth per inch.

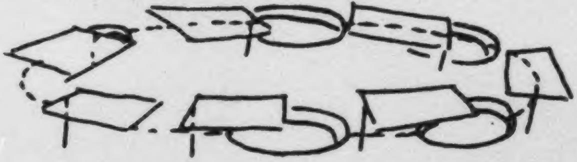


2. Hold the saw base firmly against the deck.

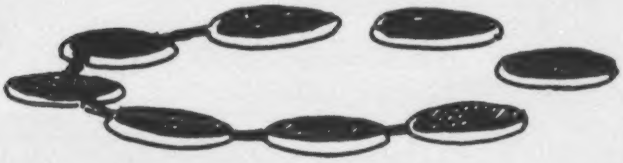
3. Start the saw and guide the blade on line where you wish to cut.



4. Continue cutting until entire hole is cut through.



COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
8. Shut off saw before removing from cut.	CAUTION: Be sure you are wearing your safety glasses.



OPERATION SHEET
SC-4-11

COMPETENCY: Driving Nails with a Claw Hammer

COURSE: Metal Fabrication

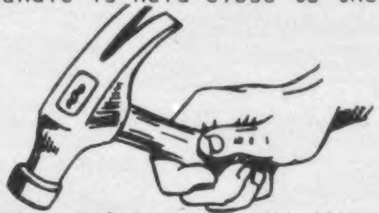
UNIT IV: Installation and Repair

OBJECTIVE: To drive nails efficiently without damaging the work or the fingers

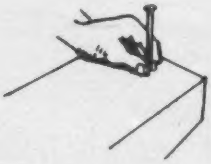
Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

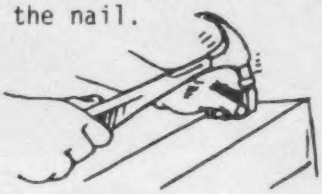
1. Hold the hammer with your fingers underneath and your thumb alongside or on top of the handle. Except for light blows, the handle is held close to the end.



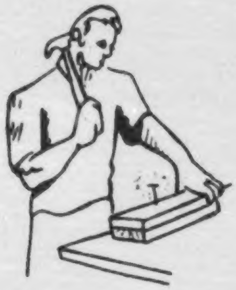
2. Hold the nail between the fingers and thumb of your other hand. Use the rest of the hand to help position the nail.



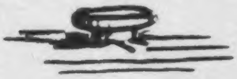
3. Rest the face of the hammer on the head of the nail. Raise the hammer slightly and give the nail a light tap. This starts the nail and will help to set the aim of the nail.



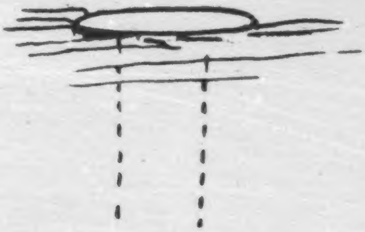
4. Line the hammer up so that the nail is struck squarely so you don't bend the nail or mar the wood.



5. Drive the nail until the head is almost level with the surface of the wood.



6. Finish driving the nail with light blows so you don't damage the surface of the wood.



OPERATION SHEET
SC-4-11A

COMPETENCY: Pulling Nails with the Claw Hammer

COURSE: Metal Fabrication

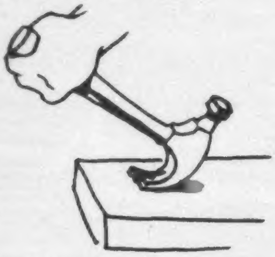
UNIT IV: Installation and Repair

OBJECTIVE: To pull nails without breaking the handle out of the hammer

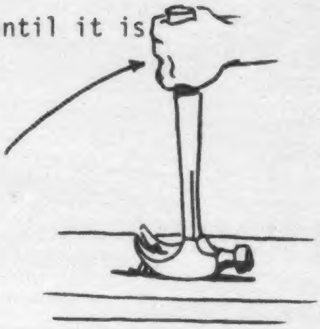
Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

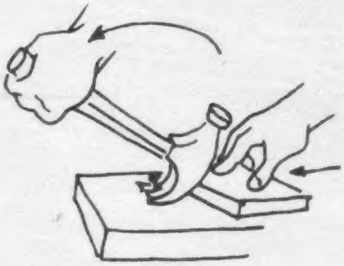
1. Set the claw of the hammer firmly under the head of the nail.



2. Pull the hammer handle until it is almost straight up.

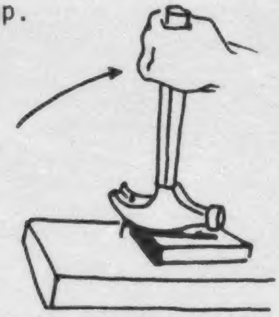


3. Tip the hammer handle forward so you can put a block of scrap wood under the head of the hammer.



COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES

4. Draw the nail again until the nail is free or until the handle is again straight up.



5. If the nail is not out, add a second block of wood and repeat step 4.

OPERATION SHEET
SC-4-12

COMPETENCY: Erect Tubular Scaffolding

COURSE: Metal Fabrication

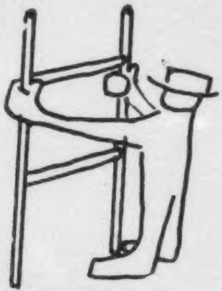
UNIT IV: Installation and Repair

OBJECTIVE: To properly set up scaffolding

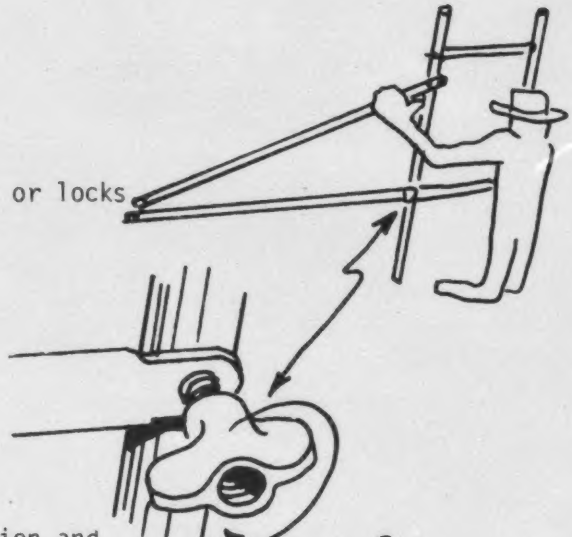
Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

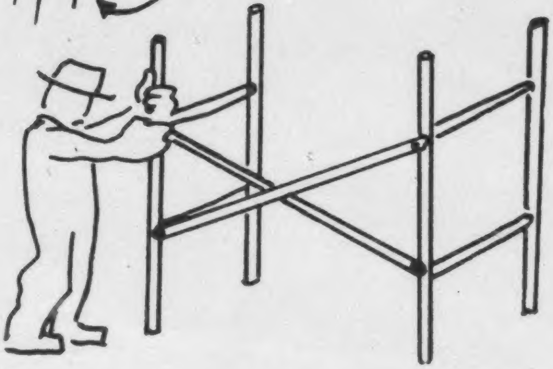
1. Place or hold upright in vertical position.



2. Install cross arms to wing nuts or locks on uprights; lock securely.



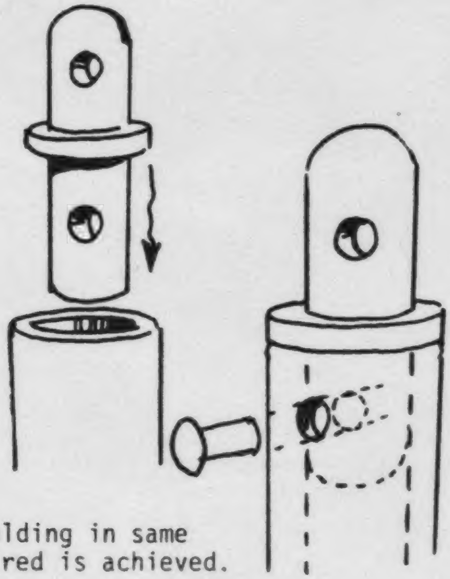
3. Place second upright into position and lock.



4. Raise and insert roller wheels into tubular openings at bottom of uprights.

5. Place pins through tube and wheel sections so they cannot fall out.

6. Install section pins in top of tubular uprights.



7. Continue erecting scaffolding in same manner until height desired is achieved.

OPERATION SHEET
SC-4-13

COMPETENCY: Install Strap Hanger on a Half Round Spout

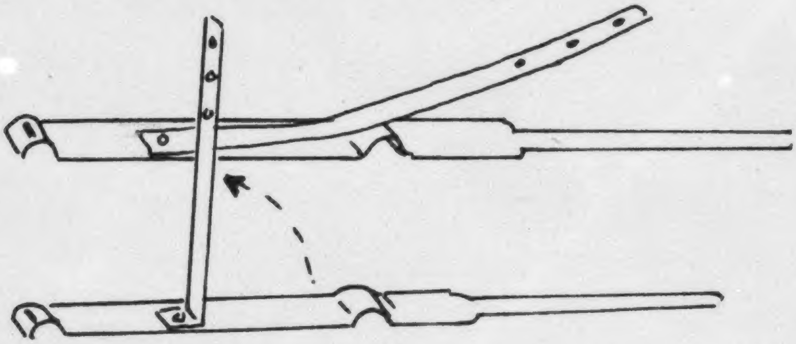
COURSE: Metal Fabrication **UNIT IV:** Installation and Repair

OBJECTIVE: To install hangers neatly and securely

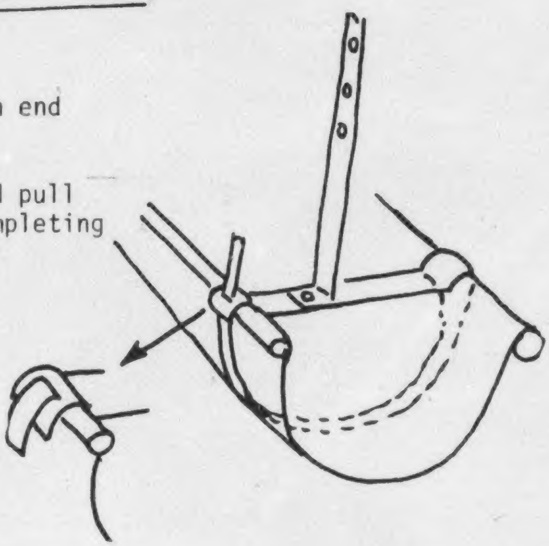
Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

1. Bend up strap near rivet.
2. Using thumb and forefingers press a slight curve into wide area below bead.



3. Wrap hanger around spout and push end of strap through slot.
4. Grip tip of strap with pliers and pull up tight. Then bend tip over completing installation.



OPERATION SHEET
SC-4-14

COMPETENCY: Erecting Extension Ladders

COURSE: Metal Fabrication

UNIT IV: Installation and Repair

OBJECTIVE: To erect extension ladders safely and securely

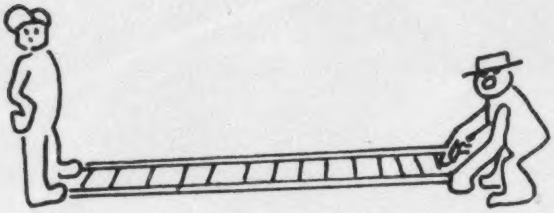
Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

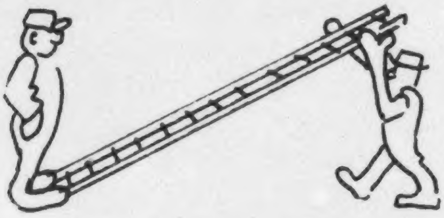
TWO MAN OPERATION

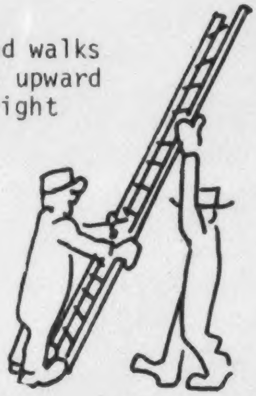
1. One man will stand on the lower end of ladder rails.

2. Second man lift upper end of ladder.

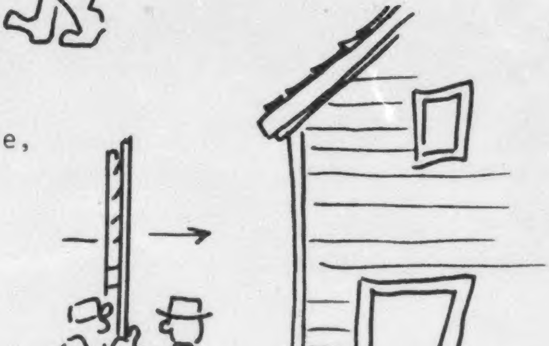


3. Second man gets under ladder and walks toward first man with his hands upward pushing the ladder up to an upright position.

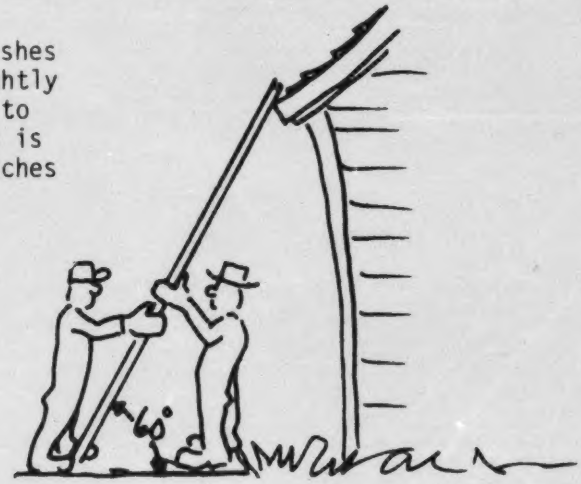




4. Set ladders against building at 60° angle, square against building with both rails set firmly and evenly on the ground.



5. To achieve proper height, man #2 pushes ladder out away from building slightly while man #1 raises upper section to proper height. When upper section is lowered on latch be sure latch catches on rung of lower section.



6. After ladder is raised readjust lower end position to re-establish 60° angle from building.

OPERATION SHEET
SC-4-15

COMPETENCY: Placing Ladder Jacks

COURSE: Metal Fabrication

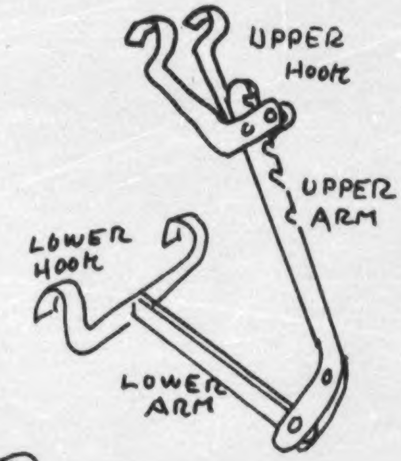
UNIT IV: Installation and Repair

OBJECTIVE: To place ladder jacks safely and securely

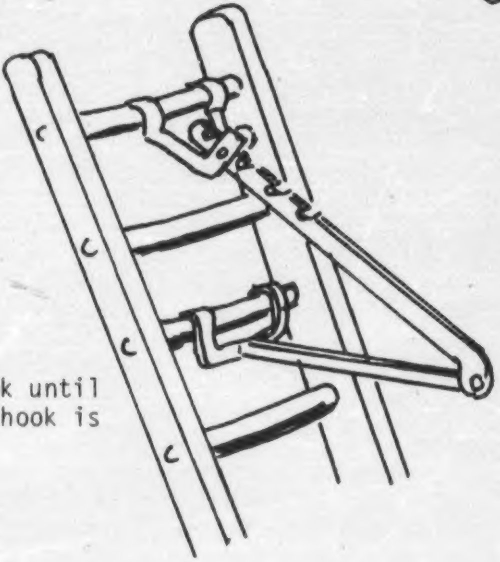
Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

1. Climb ladder with a ladder jack and hook the lower hook over the ladder rung at the level you want scaffold planks. (Some ladder jacks hook over the side rails of the ladder.)



2. Hook the upper hook over a ladder rung two rungs above lower hook.



3. Adjust upper arm through upper hook until lower arm is level, and make sure hook is securely engaged.

OPERATION SHEET
SC-4-16

COMPETENCY: Cutting a Hole in a Masonry Wall with a Star Chisel

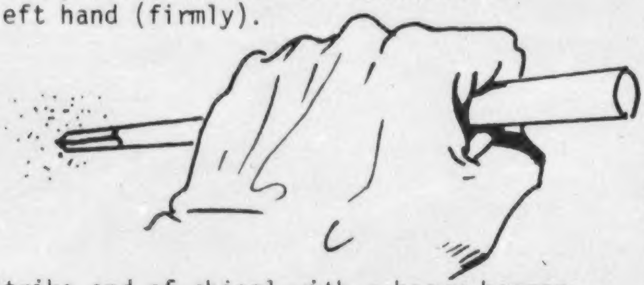
COURSE: Metal Fabrication **UNIT IV:** Installation and Repair

OBJECTIVE: To drill holes in masonry safely and quickly with star chisel

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

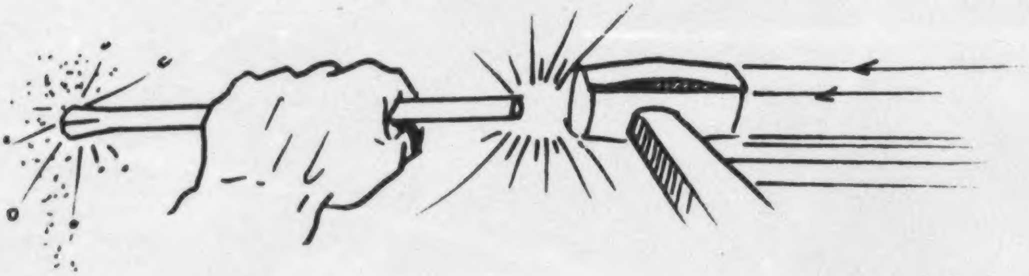
1. Hold point of chisel on location with left hand (firmly).



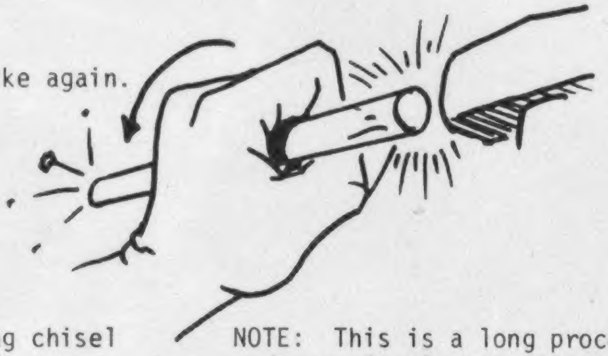
NOTE: The drill should always be held on the exact angle at which you want the hole to go.

CAUTION: Make sure all tools are in a good, safe condition and wear gloves and safety glasses.

2. Strike end of chisel with a heavy hammer.

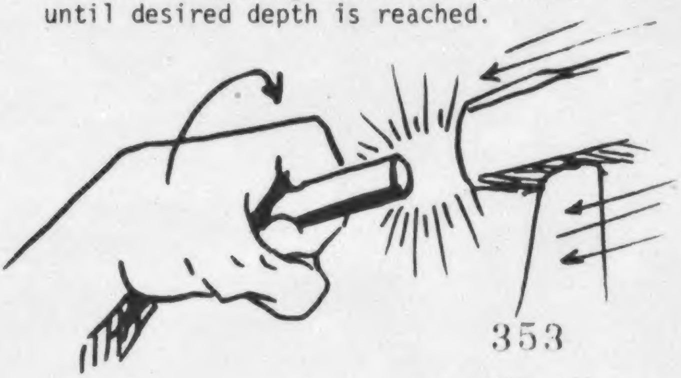


3. Rotate chisel 1 1/4 turn, strike again.



4. Continue hammering and rotating chisel until desired depth is reached.

NOTE: This is a long process and occasional rest will be needed.



OPERATION SHEET
SC-4-17

COMPETENCY: Cutting Mortar Joints with Cape Chisel and Hammer

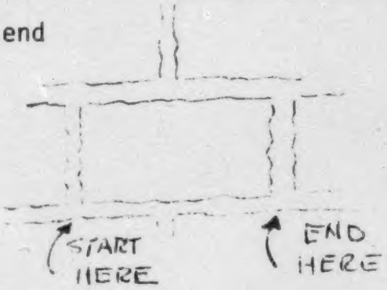
COURSE: Metal Fabrication

OBJECTIVE: To learn how to properly cut mortar joints with the cape chisel

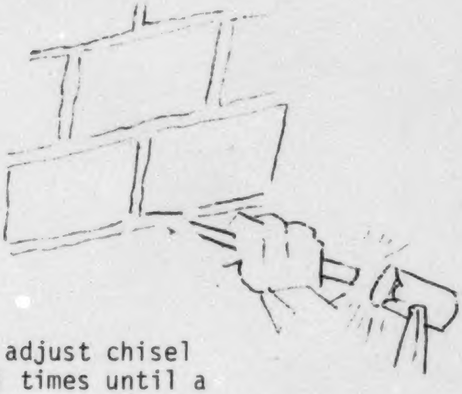
Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

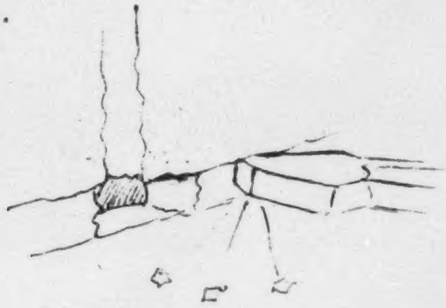
1. Place the cape chisel at the left end of the mortar joint to be cut.



2. Hold the chisel at an approximate 95° angle to the work. (Horizontally if cut is on horizontal plane.)



3. Strike with the hammer, adjust chisel point and strike several times until a slot is cut into the wall or joint the depth you desire.



COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
4. Cutting from left to right keep hitting the chisel, slowly cutting the slot or groove through the entire joint.	CAUTION: Make sure chisel head is not mushroomed and the hammer is in good condition. Safety: Wear glasses and gloves.

OPERATION SHEET
SC-4-18

COMPETENCY: Cutting Mortar Joints in Masonry Chimneys and Walls

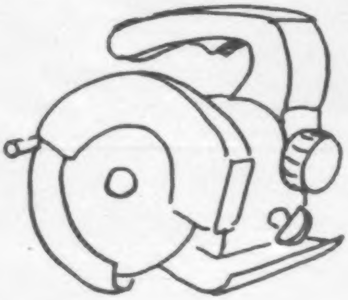
COURSE: Metal Fabrication

UNIT IV: Installation and Repair

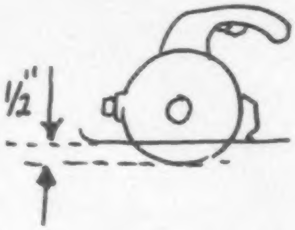
OBJECTIVE: To learn how to use the skill saw with the carborundum blade safely and efficiently

Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Check the carborundum blade to be certain it has been in the power skill saw correctly.	NOTE: Make certain you have on safety glasses and a face mask if you are in a confined area.

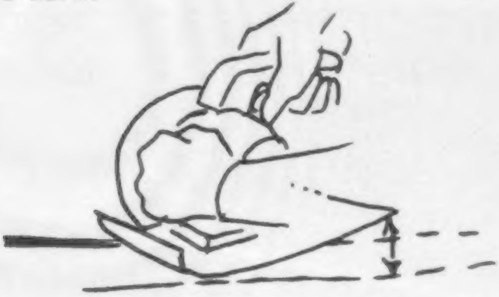


2. Set the guide plate so the blade extends 1/2" below bottom surface.

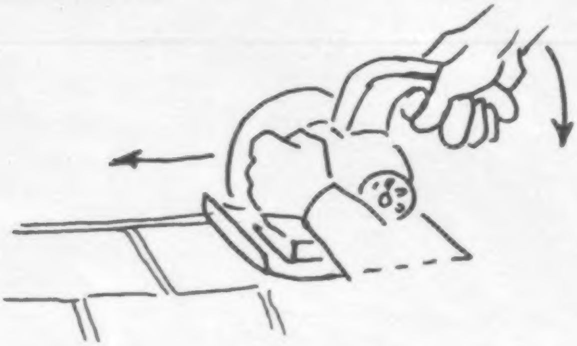


3. Place the saw on the surface to be cut. Hold the saw firmly with both hands.

4. Tip the saw so the handle or portion of saw nearest your body is up off the work.



5. Turn on the saw and slowly lower raised end until depth guide is flat on work.



6. With a slow steady speed feed the cutter through the entire joint.

OPERATION SHEET
SC-4-19

COMPETENCY: Cutting Curves with a Compass Saw

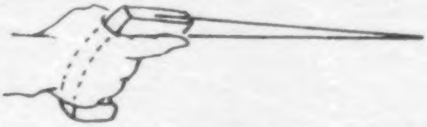
COURSE: Metal Fabrication **UNIT IV:** Installation and Repair

OBJECTIVE: To cut curves with compass saw without damage to workpiece or saw

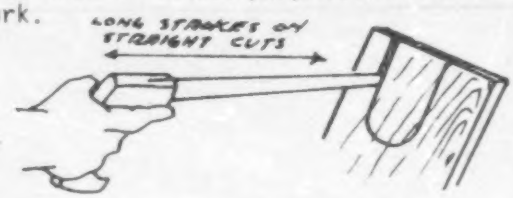
Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

1. Hold the saw as you do other hand saws--with your index finger extended along the handle.

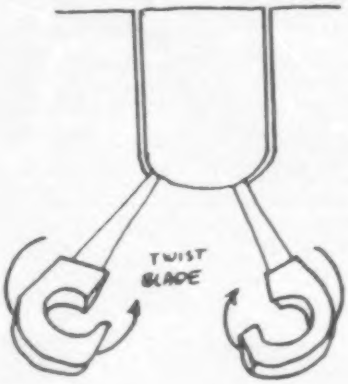


2. Hold the saw blade perpendicular to the work.

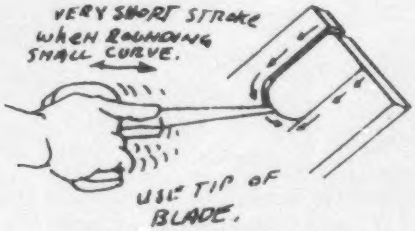

LONG STROKES ON STRAIGHT CUTS

3. Saw with short, choppy strokes.

4. To follow a curved line, twist the blade slightly in the direction of the curve.



COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
	NOTE: Don't force the saw. Forcing could make it buckle or break.
	NOTE: For small curves, use only the tip of the blade.


VERY SHORT STROKE
WHEN ROUNDING
SMALL CURVE.
USE TIP OF
BLADE.

NOTE: To make an inside cut, drill a hole big enough for the saw blade to pass through in the area to be cut out. Use the hole as a starting point to cut out the rest of the pattern.

OPERATION SHEET
SC-4-20

COMPETENCY: Using the Porta Hoist

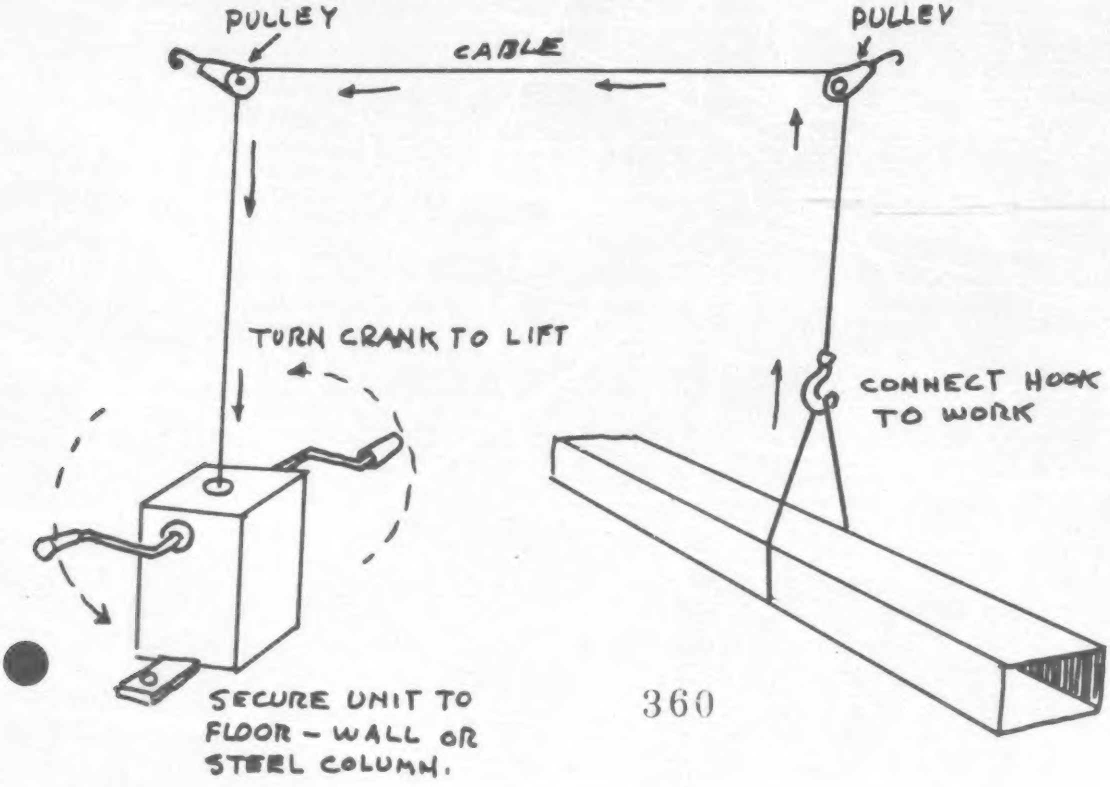
COURSE: Metal Fabrication   UNIT IV: Installation and Repair

OBJECTIVE: To learn how to properly secure and use the porta cable hoist

Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

1. Position and secure hoist to steel columns or any object that is permanently secure and will not move.
2. Fasten or secure pully directly above work to be hoisted.
3. Flip the release arm and pull out enough cable to go from the hoist up thru the pully and down to the object to be lifted.
4. Securely fasten chain, cable or clevis clamps to work and attach cable hook.
5. Reset release arm and begin turning crank arms until cable is taut.


PULLEY
CABLE
PULLEY
TURN CRANK TO LIFT
CONNECT HOOK TO WORK
SECURE UNIT TO FLOOR – WALL OR STEEL COLUMN.

6. Turn crank arm a few more turns until work is just suspended from deck.

7. Recheck all connections (be sure all are going to hold).

8. Continue to raise work until it is in position, fasten permanently.

9. Slowly release cable tension. Release cable from pully and rewind cable into hoist roll.

INFORMATION SHEET
IL-1-11

TITLE: Drawing Lines and Their Meaning

COURSE: Metal Fabrication UNIT I: PATTERN LAYOUT JOBS

Referring to Figure 1-11, horizontal lines are drawn with the upper edge of the T-square blade as a guide. The head of the T-square should be held against the left edge of the drawing board with the left hand, and moved to the desired position. The pencil should be held about an inch from the point and inclined slightly in the direction in which the line is being drawn. A plane through the pencil lead and the line being drawn should make a right angle with the surface of the guide. Care must be taken to keep the line parallel to the guiding edge. These lines should be checked carefully; they should all be neat and parallel to each other. Careful application of this information should enable you to produce improved drawings.

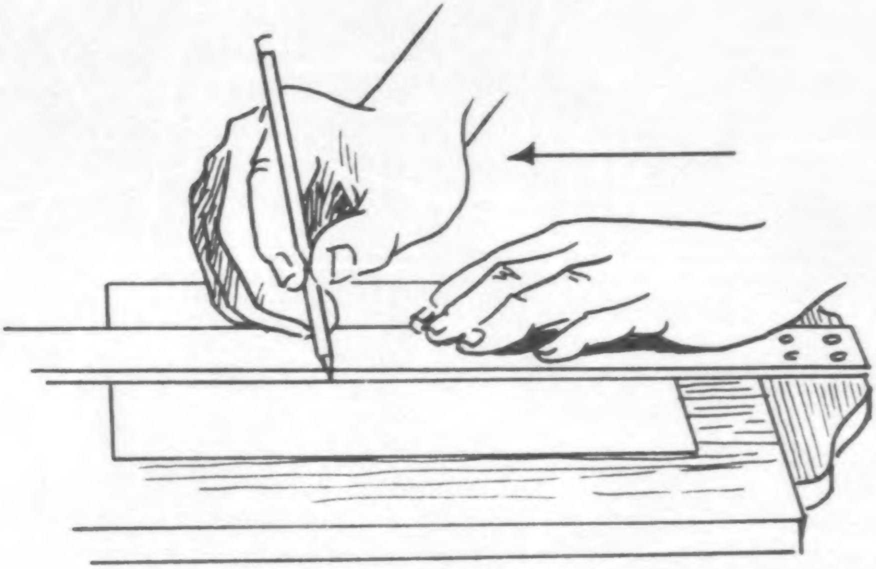


Figure 1-11 Drawing Horizontal Lines

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